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(71)Applicant : TOYOTA MOTOR CORP

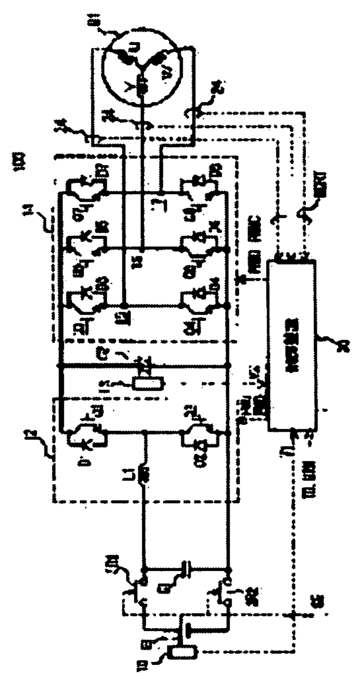
(72)Inventor : HABU MASAKAZU

(54) APPARATUS AND METHOD FOR CONVERTING VOLTAGE AND COMPUTER-READABLE RECORDING MEDIUM RECORDING PROGRAM FOR MAKING COMPUTER EXECUTE CONTROL OF VOLTAGE CONVERSION

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an apparatus for converting a voltage for converting a DC voltage into an output voltage so that the output voltage becomes a voltage command value, even when a boosted output voltage is changed.

SOLUTION: A control unit 30 receives the output voltage V2 of a boost converter 12 from a voltage sensor 13, calculates errors in the voltage command from the voltage V2, and regulates a PI control gain (proportionality gain and integration gain), in response to the calculated mistake. The unit 30 feedback controls by using the regulated PI control gain, and the converter 12 converts the DC voltage output from a DC current power source B into the voltage V2 so that the voltage V2 becomes the voltage command.



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CLAIMS

[Claim(s)]
[Claim 1] The electrical-potential-difference converter which is the electrical-potential-difference inverter which changes the direct current voltage from DC power supply into said output voltage so that output voltage may turn into a command electrical potential difference, changes the voltage level of said direct current voltage, and outputs output voltage, The error of a detection means to detect the output voltage outputted from said electrical-potential-difference converter, and said command electrical potential difference and said detected output voltage, And detect said rate of the command change of potential, and the control gain in the feedback control of said output voltage is adjusted according to said error and rate of change which were detected. An electrical-potential-difference inverter equipped with the control means which controls said electrical-potential-difference converter so that said output voltage turns into said command electrical potential difference by the feedback control using the adjusted control gain.
[Claim 2] Said detection means is an electrical-potential-difference inverter according to claim 1 which detects the input voltage to said electrical-potential-difference converter, and detects said output voltage based on the detected input voltage and the conversion ratio in said electrical-potential-difference converter.
[Claim 3] Said detection means is an electrical-potential-difference inverter according to claim 1 which detects the direct current voltage outputted from said DC power supply based on the temperature of said DC power supply, and detects said output voltage based on the detected DC power supply and the conversion ratio in said electrical-potential-difference converter.
[Claim 4] The electrical-potential-difference converter which is the electrical-potential-difference inverter which changes the direct current voltage from DC power supply into said output voltage so that output voltage may turn into a command electrical potential difference, changes the voltage level of said direct current voltage, and outputs output voltage, According to a detection means to detect fluctuation of the internal resistance of said DC power supply, and said detected fluctuation of internal resistance, the control gain in the feedback control of said output voltage is adjusted. An electrical-potential-difference inverter equipped with the control means which controls said electrical-potential-difference converter so that said output voltage turns into said command electrical potential difference by the feedback control using the adjusted control gain.
[Claim 5] The 1st gain adjustment which as for said control means lowers said control gain smaller [said rate of change] than the 1st reference value when the absolute value of said error is larger than the 2nd reference value is performed. The 2nd gain adjustment which raises said control gain more greatly [said rate of change] than said 1st reference value when the absolute value of said error is larger than said 2nd reference value is performed. When [when said rate of change is smaller than said 1st reference value] the absolute value of said error is smaller than said 2nd reference value, Or an electrical-potential-difference inverter given in any 1 term of claim 1 to claim 4 which performs the 3rd gain adjustment which holds said control gain more greatly [said rate of change] than said 1st reference value when the absolute value of said error is smaller than said 2nd reference value.
[Claim 6] The rate-of-change judging section which judges whether said control means detects said rate of the command change of potential, and said detected rate of change is smaller than said 1st reference value, The control gain controller which performs either of said the 1st to 3rd gain adjustment based on the error detecting element which detects the error of said command electrical potential difference and said output voltage, and the judgment result from said rate-of-change judging section and the error from said error detecting element, The electrical-potential-difference inverter containing the control section which controls said electrical-potential-difference converter so that said output voltage turns into said command electrical potential difference using the control gain adjusted by said control gain controller according to claim 5.
[Claim 7] Said output voltage is an electrical-potential-difference inverter given in any 1 term of claim 1 to claim 6 inputted into the inverter which drives an AC motor.

[Claim 8] The electrical-potential-difference converter which is the electrical-potential-difference inverter which changes the direct current voltage from DC power supply into said output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, changes the voltage level of said direct current voltage, and outputs output voltage, According to a mode detection means to detect the control mode of said AC motor, and said detected control mode, the control gain in the feedback control of said output voltage is adjusted. An electrical-potential-difference inverter equipped with the control means which controls said electrical-potential-difference converter so that said output voltage turns into said command electrical potential difference by the feedback control using the adjusted control gain.
[Claim 9] The electrical-potential-difference converter which is the electrical-potential-difference inverter which changes the direct current voltage from DC power supply into said output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, changes the voltage level of said direct current voltage, and outputs output voltage, A mode detection means to detect the control mode of said AC motor, and an electrical-potential-difference detection means to detect the output voltage outputted from said electrical-potential-difference converter, The error of said command electrical potential difference and said detected output voltage, and a detection means to detect said rate of the command change of potential, The control gain in the feedback control of said output voltage is adjusted to the suitable control gain for said detected control mode. The adjusted suitable control gain is further adjusted to the optimal control gain based on said error and rate of change which were detected. An electrical-potential-difference inverter equipped with the control means which controls said electrical-potential-difference converter so that said output voltage turns into said command electrical potential difference by the feedback control using the adjusted optimal control gain.
[Claim 10] At the time of the adjustment to said optimal suitable control gain from said control gain, said control means The 1st gain adjustment which lowers said control gain smaller [said rate of change] than the 1st reference value when the absolute value of said error is larger than the 2nd reference value is performed. The 2nd gain adjustment which raises said control gain more greatly [said rate of change] than said 1st reference value when the absolute value of said error is larger than said 2nd reference value is performed. When [when said rate of change is smaller than said 1st reference value] the absolute value of said error is smaller than said 2nd reference value, Or the electrical-potential-difference inverter according to claim 9 which performs the 3rd gain adjustment which holds said control gain more greatly [said rate of change] than said 1st reference value when the absolute value of said error is smaller than said 2nd reference value.
[Claim 11] The rate-of-change judging section which judges whether said control means detects said rate of the command change of potential, and said detected rate of change is smaller than said 1st reference value, The control gain controller which performs either of said the 1st to 3rd gain adjustment based on the error detecting element which detects the error of said command electrical potential difference and said output voltage, and the judgment result from said rate-of-change judging section and the error from said error detecting element, The electrical-potential-difference inverter containing the control section which controls said electrical-potential-difference converter so that said output voltage turns into said command electrical potential difference using the control gain adjusted by said control gain controller according to claim 10.
[Claim 12] Said mode detection means is an electrical-potential-difference inverter given in any 1 term of claim 8 to claim 11 which detects the control mode from which a carrier frequency differs.
[Claim 13] Said control means is an electrical-potential-difference inverter according to claim 12 which adjusts said control gain according to the carrier frequency of said detected control mode.
[Claim 14] Said control means is an electrical-potential-difference inverter according to claim 13 which adjusts said control gain to larger control gain than control gain when said carrier frequency is low as the carrier frequency of said detected control mode becomes high.
[Claim 15] It is an electrical-potential-difference inverter given in any 1 term of claim 8 to claim 11 to which said mode detection means detects two or more control modes corresponding to two or more AC motors, and said control means adjusts said control gain according to said two or more detected control modes.
[Claim 16] Said control means is an electrical-potential-difference inverter according to claim 15 which detects the power fluctuation in said feedback control for which it opts according to the combination of two or more of said detected control modes, and adjusts said control gain according to the detected power fluctuation.
[Claim 17] Said control means is an electrical-potential-difference inverter according to claim 16 which enlarges the range of the cut of said control gain, and adjusts said control gain, so that said detected power

fluctuation is large.
[Claim 18] Said mode detection means is an electrical-potential-difference inverter given in any 1 term of claim 8 to claim 17 which receives the rotational frequency of said AC motor, and the torque of said AC motor, and detects said control mode based on the rotational frequency and torque which were received.
[Claim 19] Said mode detection means is an electrical-potential-difference inverter according to claim 18 which holds the map in which the relation of said rotational frequency and said torque is shown, and detects said control mode by detecting the field of said map on which said rotational frequency and torque which were received are included.
[Claim 20] Said control gain is an electrical-potential-difference inverter given in any 1 term of claim 1 to claim 19 which is the PI control gain in feedback control.
[Claim 21] Said AC motor is an electrical-potential-difference inverter according to claim 20 which is a motor for cars.
[Claim 22] The 1st step which is the electrical-potential-difference conversion approach of changing the direct current voltage from DC power supply into said output voltage so that output voltage may turn into a command electrical potential difference, and detects said output voltage, The error of said command electrical potential difference and said output voltage, and the 2nd step which detects said rate of the command change of potential, The 3rd step which adjusts the control gain in the feedback control of said output voltage based on said rate of change and said error, The electrical-potential-difference conversion approach containing the 4th step which changes said direct current voltage into said output voltage so that said output voltage may turn into said command electrical potential difference by the feedback control using said adjusted control gain.
[Claim 23] Said 1st step is the electrical-potential-difference conversion approach containing the 2nd substep which detects said output voltage based on the 1st substep which detects the input voltage inputted into the electrical-potential-difference transducer which changes said direct current voltage into said output voltage, and said detected input voltage and the conversion ratio in said electrical-potential-difference transducer according to claim 22.
[Claim 24] Said 1st step is the electrical-potential-difference conversion approach containing the 2nd substep which detects said output voltage based on the 1st substep which detects the temperature of said DC power supply and detects the input voltage inputted into the electrical-potential-difference transducer which changes said direct current voltage into said output voltage based on the detected temperature, said detected input voltage, and the conversion ratio in said electrical-potential-difference transducer according to claim 22.
[Claim 25] In said 3rd step, said rate of change is smaller than the 1st reference value. And when the absolute value of said error is larger than the 2nd reference value, said control gain is lowered. More greatly [said rate of change] than said 1st reference value, when the absolute value of said error is larger than said 2nd reference value, said control gain is raised. When [when said rate of change is smaller than said 1st reference value] the absolute value of said error is smaller than said 2nd reference value, Or it is the electrical-potential-difference conversion approach given in any 1 term of claim 22 to claim 24 by which said control gain is held when [than said 1st reference value / when said rate of change is larger] the absolute value of said error is smaller than said 2nd reference value.
[Claim 26] The 1st step which is the electrical-potential-difference conversion approach of changing the direct current voltage from DC power supply into said output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, and detects the control mode of said AC motor, The 2nd step which adjusts the control gain in the feedback control of said output voltage according to said detected control mode, The electrical-potential-difference conversion approach containing the 3rd step which changes said direct current voltage into said output voltage so that said output voltage may turn into said command electrical potential difference by the feedback control using said adjusted control gain.
[Claim 27] The 1st step which is the electrical-potential-difference conversion approach of changing the direct current voltage from DC power supply into said output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, and detects the control mode of said AC motor, The 2nd step which adjusts the control gain in the feedback control of said output voltage to the suitable control gain for said detected control mode, The 3rd step which detects said output voltage, and the error of said command electrical potential difference and said output voltage and the 4th step which detects said rate of the command change of potential, The 5th step which adjusts said suitable control gain to the optimal control gain based on said rate of change and error which were detected, The electrical-potential-difference conversion approach containing the 6th step which changes said direct current voltage into said

output voltage so that said output voltage may turn into said command electrical potential difference by the feedback control using said adjusted optimal control gain.
[Claim 28] In said 5th step, said rate of change is smaller than the 1st reference value. And when the absolute value of said error is larger than the 2nd reference value, said suitable control gain is lowered and is adjusted to said optimal control gain. More greatly [said rate of change] than said 1st reference value, when the absolute value of said error is larger than said 2nd reference value, said suitable control gain is raised and is adjusted to said optimal control gain. When [when said rate of change is smaller than said 1st reference value] the absolute value of said error is smaller than said 2nd reference value, Or it is the electrical-potential-difference conversion approach according to claim 27 which said suitable control gain is held when [than said 1st reference value / when said rate of change is larger] the absolute value of said error is smaller than said 2nd reference value, and is adjusted to said optimal control gain.
[Claim 29] The control mode detected in said 1st step is the electrical-potential-difference conversion approach given in any 1 term of claim 26 to claim 28 which is the control mode from which a carrier frequency differs.
[Claim 30] It is the electrical-potential-difference conversion approach according to claim 26 or 27 that said control gain is adjusted [in / the control modes detected in said 1st step are two or more control modes over two or more AC motors, and / said 2nd step] according to said two or more detected control modes.
[Claim 31] It is the electrical-potential-difference conversion approach given in any 1 term of claim 26 to claim 30 by which said control mode is detected in said 1st step based on the rotational frequency and torque of said AC motor.
[Claim 32] Said control gain is the electrical-potential-difference conversion approach given in any 1 term of claim 22 to claim 31 which is the PI control gain in feedback control.
[Claim 33] It is the record medium which recorded the program for making a computer perform control of the electrical-potential-difference conversion which changes the direct current voltage from DC power supply into said output voltage so that output voltage may turn into a command electrical potential difference and in which computer read is possible. The 1st step which detects said output voltage, and the error of said command electrical potential difference and said output voltage and the 2nd step which detects said rate of the command change of potential, The 3rd step which adjusts the control gain in the feedback control of said output voltage based on said rate of change and said error, The record medium which recorded the program for making a computer perform the 4th step which transforms said direct current voltage to said output voltage so that said output voltage may turn into said command electrical potential difference by the feedback control using said adjusted control gain and in which computer read is possible.
[Claim 34] Said 1st step is a record medium which recorded the program containing the 2nd substep which detects said output voltage based on the 1st substep which detects the input voltage inputted into the electrical-potential-difference transducer which changes said direct current voltage into said output voltage, and said detected input voltage and the conversion ratio in said electrical-potential-difference transducer for performing a computer according to claim 33 and in which computer read is possible.
[Claim 35] The 1st substep which said 1st step detects the temperature of said DC power supply, and detects the input voltage inputted into the electrical-potential-difference transducer which changes said direct current voltage into said output voltage based on the detected temperature, The record medium which recorded the program containing the 2nd substep which detects said output voltage based on said detected input voltage and the conversion ratio in said electrical-potential-difference transducer for performing a computer according to claim 33 and in which computer read is possible.
[Claim 36] In said 3rd step, said rate of change is smaller than the 1st reference value. And when the absolute value of said error is larger than the 2nd reference value, said PI control gain is lowered. More greatly [said rate of change] than said 1st reference value, when the absolute value of said error is larger than said 2nd reference value, said PI control gain is raised. When [when said rate of change is smaller than said 1st reference value] the absolute value of said error is smaller than said 2nd reference value, Or more greatly [said rate of change] than said 1st reference value, when the absolute value of said error is smaller than said 2nd reference value, said PI control gain is held. The record medium which recorded the program for performing the computer of a publication on any 1 term of claim 33 to claim 35 and in which computer read is possible.
[Claim 37] It is the record medium which recorded the program for making a computer perform control of the electrical-potential-difference conversion which changes the direct current voltage from DC power supply into said output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference and in which computer read is possible. The 1st step which detects the control mode of said AC motor, and the 2nd step which adjusts the control gain in the feedback control of said

output voltage according to said detected control mode, The record medium which recorded the program for making a computer perform the 3rd step which changes said direct current voltage into said output voltage so that said output voltage may turn into said command electrical potential difference by the feedback control using said adjusted control gain and in which computer read is possible.

[Claim 38] It is the record medium which recorded the program for making a computer perform control of the electrical-potential-difference conversion which changes the direct current voltage from DC power supply into said output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference and in which computer read is possible. The 1st step which detects the control mode of said AC motor, and the 2nd step which adjusts the control gain in the feedback control of said output voltage to the suitable control gain for said detected control mode, The 3rd step which detects said output voltage, and the error of said command electrical potential difference and said output voltage and the 4th step which detects said rate of the command change of potential, The 5th step which adjusts said suitable control gain to the optimal control gain based on said rate of change and error which were detected, The record medium which recorded the program for making a computer perform the 6th step which changes said direct current voltage into said output voltage so that said output voltage may turn into said command electrical potential difference by the feedback control using said adjusted optimal control gain and in which computer read is possible.

[Claim 39] In said 5th step, said rate of change is smaller than the 1st reference value. And when the absolute value of said error is larger than the 2nd reference value, said suitable control gain is lowered and is adjusted to said optimal control gain. More greatly [said rate of change] than said 1st reference value, when the absolute value of said error is larger than said 2nd reference value, said suitable control gain is raised and is adjusted to said optimal control gain. When [when said rate of change is smaller than said 1st reference value] the absolute value of said error is smaller than said 2nd reference value, Or more greatly [said rate of change] than said 1st reference value, when the absolute value of said error is smaller than said 2nd reference value, said suitable control gain is held and are adjusted to said optimal control gain. The record medium which recorded the program for performing a computer according to claim 38 and in which computer read is possible.

[Claim 40] The control mode detected in said 1st step is a record medium which recorded the program for performing a computer given in any 1 term of claim 37 to claim 39 which is the control mode from which a carrier frequency differs and in which computer read is possible.

[Claim 41] It is the record medium in which the control modes detected in said 1st step are two or more control modes over two or more AC motors, and the computer read which recorded the program for performing a computer according to claim 37 or 38 to which said control gain is adjusted according to said two or more detected control modes in said 2nd step is possible.

[Claim 42] It is the record medium with which said control mode is detected in said 1st step based on the rotational frequency and torque of said AC motor, which recorded the program for performing a computer given in any 1 term of claim 37 to claim 41 and in which computer read is possible.

[Claim 43] Said control gain is a record medium which recorded the program for performing a computer given in any 1 term of claim 33 to claim 42 which is the PI control gain in feedback control and in which computer read is possible.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the record medium which recorded the program for making a computer perform control of the electrical-potential-difference conversion which changes into a command electrical potential difference the electrical-potential-difference inverter which changes the direct current voltage from DC power supply into a command electrical potential difference, the electrical-potential-difference conversion approach of changing direct current voltage into a command electrical potential difference, and direct current voltage and in which computer read is possible.
[0002]
[Description of the Prior Art] Recently, the attention with big hybrid car (Hybrid Vehicle) and electric vehicle (Electric Vehicle) as an automobile which considered the environment is attracted. And a part of hybrid car is put in practical use.
[0003] This hybrid car is an automobile which makes the motor driven with DC power supply, an inverter, and an inverter the source of power in addition to the conventional engine. That is, while obtaining the source of power by driving an engine, the direct current voltage from DC power supply is changed into an alternating current with an inverter, and the source of power is obtained by rotating a motor by the changed alternating current. Moreover, an electric vehicle is an automobile which makes the motor driven with DC power supply, an inverter, and an inverter the source of power.
[0004] In such a hybrid car or an electric vehicle, the pressure up of the direct current voltage from DC power supply is carried out by the pressure-up converter, and the direct current voltage which carried out the pressure up is supplied to the inverter which drives a motor.
[0005] That is, the hybrid car or the electric vehicle carries the motorised equipment shown in drawing 33 . Motorised equipment 300 is equipped with DC power supply B, the system relays SR1 and SR2, capacitors C1 and C2, the bidirectional converter 310, a voltage sensor 320, and an inverter 330 with reference to drawing 33 .
[0006] DC power supply B output direct current voltage. If the system relays SR1 and SR2 are turned on by the control device (not shown), they will supply the direct current voltage from DC power supply B to a capacitor C1. A capacitor C1 graduates the direct current voltage supplied through the system relays SR1 and SR2 from DC power supply B, and supplies the graduated direct current voltage to the bidirectional converter 310.
[0007] The bidirectional converter 310 contains a reactor 311, NPN transistor 312,313, and diode 314,315. The one side edge of a reactor 311 is connected to power-source Rhine of DC power supply B, and an another side edge is connected between the midpoint of NPN transistor 312 and NPN transistor 313, i.e., the emitter of NPN transistor 312, and the collector of NPN transistor 313. NPN transistor 312,313 is connected to a serial between power-source Rhine and an earth line. And the collector of NPN transistor 312 is connected to power-source Rhine, and the emitter of NPN transistor 313 is connected to an earth line. Moreover, between the collector emitters of each NPN transistor 312,313, the diode 314,315 which passes a current from an emitter side to a collector side is arranged.
[0008] With a control device (not shown), NPN transistor 312,313 is turned on / turned off, and the bidirectional converter 310 carries out the pressure up of the direct current voltage supplied from the capacitor C1, and supplies output voltage to a capacitor C2. Moreover, at the time of regenerative braking of the hybrid car or electric vehicle in which motorised equipment 300 was carried, the bidirectional converter 310 is generated by AC motor M1, lowers the pressure of the direct current voltage changed by the inverter 330, and supplies it to a capacitor C1.
[0009] A capacitor C2 graduates the direct current voltage supplied from the bidirectional converter 310,

and supplies the graduated direct current voltage to an inverter 330. A voltage sensor 320 detects the electrical potential difference Vc of the both sides of a capacitor C2, i.e., the output voltage of the bidirectional converter 310.

[0010] If direct current voltage is supplied from a capacitor C2, an inverter 330 will change direct current voltage into alternating voltage based on the control from a control unit (not shown), and will drive AC motor M1. This drives AC motor M1 so that the torque specified with the torque command value may be generated. Moreover, at the time of regenerative braking of the hybrid car or electric vehicle in which motorised equipment 300 was carried, an inverter 330 changes into direct current voltage the alternating voltage which AC motor M1 generated based on the control from a control device, and supplies the changed direct current voltage to the bidirectional converter 310 through a capacitor C2.

[0011] In motorised equipment 300, when carrying out the pressure up of the direct current voltage outputted from DC power supply B and supplying output voltage Vc to an inverter 330, feedback control is carried out so that the output voltage Vc which the voltage sensor 320 detected may become electrical-potential-difference command Vdc_com. And this feedback control is PI control and PI control gain is determined that output voltage Vc will become electrical-potential-difference command Vdc_com.

[0012] Thus, in conventional motorised equipment, PI control gain is determined, and it is controlled by feedback control using the determined PI control gain so that the output voltage Vc by which the pressure up was carried out becomes electrical-potential-difference command Vdc_com.

[0013]

[Problem(s) to be Solved by the Invention] However, when PI control gain is determined under a certain conditions, it fixes to the determined PI control gain and the internal resistance of DC power supply changes with a temperature change or long term deterioration, the problem that it is uncontrollable so that the output voltage Vc of a bidirectional converter becomes electrical-potential-difference command Vdc_com arises. For example, when the internal resistance of DC power supply becomes small, the output voltage of a bidirectional converter carries out hunting (vibration), and when the internal resistance of DC power supply becomes large, the output voltage of a bidirectional converter overshoots or undershoots.

[0014] Such a problem is produced also when the reactor which constitutes a bidirectional converter deteriorates.

[0015] Moreover, there are the PWM control mode, the overmodulation control mode, and the rectangle control mode as control mode of AC motor M1 in an inverter 330. And these control modes are a frequency (it is called a "carrier frequency".) which turns on / turns off the NPN transistor contained in an inverter 330. Hereafter, it is the same. It differs mutually.

[0016] Therefore, when the control gain suitable for a certain control mode is determined, it fixed to the determined control gain and it changes into the control modes other than the control mode with the control mode of AC motor M1, there is a problem that hunting (vibration), overshoot, and undershooting arise. [of output voltage]

[0017] Then, it is offering the electrical-potential-difference inverter which changes direct current voltage into output voltage so that it is made in order that this invention may solve this problem, and output voltage's may turn into a command electrical potential difference, even if it changes the control mode of the output voltage or the motor by which the pressure up of that purpose was carried out.

[0018] Moreover, another purpose of this invention is offering the electrical-potential-difference conversion approach of changing direct current voltage into output voltage so that output voltage's may become an electrical-potential-difference command, even if it changes the control mode of the output voltage by which the pressure up was carried out, or a motor.

[0019] Furthermore, another purpose of this invention is offering the record medium which recorded the program for making a computer perform control of the electrical-potential-difference conversion which changes direct current voltage into output voltage so that output voltage may become an electrical-potential-difference command and in which computer read's is possible, even if it changes the control mode of the output voltage by which the pressure up was carried out, or a motor.

[0020]

[The means for solving a technical problem and an effect of the invention] The electrical-potential-difference converter to which according to this invention an electrical-potential-difference inverter is an electrical-potential-difference inverter which changes the direct current voltage from DC power supply into output voltage so that output voltage may turn into a command electrical potential difference, changes the voltage level of direct current voltage into, and outputs output voltage, The error of a detection means to detect the output voltage outputted from the electrical-potential-difference converter, and a command electrical potential difference and the detected output voltage, And detect the rate of the command change of

potential, and the control gain in the feedback control of output voltage is adjusted according to the error and rate of change which were detected. It has the control means which controls an electrical-potential-difference converter so that output voltage turns into a command electrical potential difference by the feedback control using the adjusted control gain.
[0021] The control gain in feedback control is adjusted according to fluctuation of the output voltage from an electrical-potential-difference transducer. And feedback control is carried out so that output voltage may turn into a command electrical potential difference using the adjusted control gain.
[0022] Therefore, even if it changes the output voltage of an electrical-potential-difference converter, output voltage can be made in agreement with a command electrical potential difference according to this invention.
[0023] Preferably, a detection means detects the input voltage to an electrical-potential-difference converter, and detects output voltage based on the detected input voltage and the conversion ratio in an electrical-potential-difference converter.
[0024] The input voltage to an electrical-potential-difference converter is detected, and the output voltage of an electrical-potential-difference converter is called for. And feedback control is carried out so that output voltage may be in agreement with a command electrical potential difference.
[0025] Therefore, even if it changes the input voltage to an electrical-potential-difference converter, output voltage can be made in agreement with a command electrical potential difference according to this invention.
[0026] Preferably, a detection means detects the direct current voltage outputted from DC power supply based on the temperature of DC power supply, and detects output voltage based on the detected DC power supply and the conversion ratio in an electrical-potential-difference converter.
[0027] The direct current voltage outputted from DC power supply is detected, and the output voltage of an electrical-potential-difference converter is called for. And feedback control is carried out so that output voltage may be in agreement with a command electrical potential difference.
[0028] Therefore, even if it changes the direct current voltage outputted from DC power supply, output voltage can be made in agreement with a command electrical potential difference according to this invention.
[0029] Moreover, the electrical-potential-difference converter to which according to this invention an electrical-potential-difference inverter is an electrical-potential-difference inverter which changes the direct current voltage from DC power supply into output voltage so that output voltage may turn into a command electrical potential difference, changes the voltage level of direct current voltage into, and outputs output voltage, According to a detection means to detect fluctuation of the internal resistance of DC power supply, and fluctuation of the detected internal resistance, the control gain in the feedback control of output voltage is adjusted. It has the control means which controls an electrical-potential-difference converter so that output voltage turns into a command electrical potential difference by the feedback control using the adjusted control gain.
[0030] Fluctuation of the internal resistance of DC power supply is detected, and the control gain in feedback control is adjusted according to fluctuation of the detected internal resistance. And feedback control is carried out so that output voltage may turn into a command electrical potential difference using the adjusted control gain.
[0031] Therefore, even if it changes the internal resistance of DC power supply, output voltage can be made in agreement with a command electrical potential difference according to this invention.
[0032] The rate of the command change of potential of a control means is smaller than the 1st reference value preferably. And the 1st gain adjustment which lowers control gain when the absolute value of the error of a command electrical potential difference and output voltage is larger than the 2nd reference value is performed. The 2nd gain adjustment which raises control gain more greatly [rate of change] than the 1st reference value when an absolute value with error is larger than the 2nd reference value is performed. Smaller [rate of change] than the 1st reference value, when an absolute value with error is smaller than the 2nd reference value, or when [than the 1st reference value / when rate of change is larger] an absolute value with error is smaller than the 2nd reference value, the 3rd gain adjustment holding control gain is performed.
[0033] It is detected by the error of the rate of the command change of potential, and a command electrical potential difference and the output voltage of an electrical-potential-difference transducer whether feedback control is in a hunting condition, an overshoot condition, and which condition of undershooting information, and control gain is adjusted according to each of that detected condition.
[0034] Therefore, according to this invention, even if it changes the output voltage of an electrical-potential-

difference converter, the control gain for making output voltage in agreement with a command electrical potential difference can be set up exactly.

[0035] A control means contains the rate-of-change judging section, an error detecting element, a control gain controller, and a control section more preferably. The rate-of-change judging section detects the rate of the command change of potential, and judges whether the detected rate of change is smaller than the 1st reference value. An error detecting element detects the error of a command electrical potential difference and output voltage. A control gain controller performs either of the 1st to 3rd gain adjustment based on the judgment result from the rate-of-change judging section, and the error from an error detecting element. A control section controls an electrical-potential-difference converter so that output voltage turns into a command electrical potential difference using the control gain adjusted by the control gain controller.

[0036] The error of the rate of the command change of potential, and a command electrical potential difference and the output voltage of an electrical-potential-difference converter is detected independently. And control gain is adjusted according to the rate of change and error which were detected, and feedback control is carried out so that output voltage may be in agreement with a command electrical potential difference using the adjusted control gain, so that output voltage may be made in agreement with a command electrical potential difference.

[0037] Therefore, even if output voltage shifts from a command electrical potential difference according to a certain factor, output voltage can be exactly made in agreement with a command electrical potential difference according to this invention.

[0038] Output voltage is inputted into the inverter which drives an AC motor still more preferably.

[0039] An inverter changes the output voltage from an electrical-potential-difference converter into alternating voltage, and drives a motor.

[0040] Therefore, according to this invention, the torque of a motor can be stabilized. According to this invention, furthermore, an electrical-potential-difference inverter The electrical-potential-difference converter which is the electrical-potential-difference inverter which changes the direct current voltage from DC power supply into output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, changes the voltage level of direct current voltage and outputs output voltage, According to a mode detection means to detect the control mode of an AC motor, and the detected control mode, the control gain in the feedback control of output voltage is adjusted. It has the control means which controls an electrical-potential-difference converter so that output voltage turns into a command electrical potential difference by the feedback control using the adjusted control gain.

[0041] The control mode of an AC motor is detected and the control gain in feedback control is adjusted according to the detected control mode. And feedback control is carried out so that the output voltage of an electrical-potential-difference transducer may turn into a command electrical potential difference using the adjusted control gain.

[0042] Therefore, according to this invention, even if it changes the control mode of an AC motor, feedback control can be performed so that output voltage may be in agreement with a command electrical potential difference.

[0043] According to this invention, furthermore, an electrical-potential-difference inverter The electrical-potential-difference converter which is the electrical-potential-difference inverter which changes the direct current voltage from DC power supply into output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, changes the voltage level of direct current voltage and outputs output voltage, A mode detection means to detect the control mode of an AC motor, and an electrical-potential-difference detection means to detect the output voltage outputted from the electrical-potential-difference converter, A detection means to detect the error and the rate of the command change of potential of a command electrical potential difference and the detected output voltage, It adjusts to the suitable control gain for the control mode which had the control gain in the feedback control of output voltage detected. Based on the error and rate of change which had the adjusted suitable control gain detected, it adjusts to the optimal control gain further, and has the control means which controls an electrical-potential-difference converter so that output voltage turns into a command electrical potential difference by the feedback control using the adjusted optimal control gain.

[0044] The control mode of an AC motor is detected and the control gain in the feedback control of the output voltage from an electrical-potential-difference transducer is adjusted to the suitable control gain for the detected control mode. And fluctuation of output voltage is detected, according to fluctuation of the detected output voltage, suitable control gain is adjusted further and the control gain in feedback control is set as the optimal control gain. If it does so, feedback control will be performed so that output voltage may be in agreement with a command electrical potential difference using the optimal control gain.

[0045] Therefore, according to this invention, output voltage can be made in agreement with a command electrical potential difference to fluctuation of the control mode of an AC motor, or fluctuation of output voltage.
[0046] At the time of the adjustment to the optimal suitable control gain from control gain, preferably a control means The 1st gain adjustment which lowers control gain smaller [the rate of the command change of potential] than the 1st reference value when the absolute value of the error of a command electrical potential difference and output voltage is larger than the 2nd reference value is performed. The 2nd gain adjustment which raises control gain more greatly [rate of change] than the 1st reference value when an absolute value with error is larger than the 2nd reference value is performed. Smaller [rate of change] than the 1st reference value, when an absolute value with error is smaller than the 2nd reference value, or when [than the 1st reference value / when rate of change is larger] an absolute value with error is smaller than the 2nd reference value, the 3rd gain adjustment holding control gain is performed.
[0047] Control gain is adjusted according to each control mode of a motor, at the time of the adjustment to the optimal suitable control gain from control gain, it is detected by the error of the rate of the command change of potential, and a command electrical potential difference and the output voltage of an electrical-potential-difference transducer whether feedback control is in a hunting condition, an overshoot condition, and which condition of undershooting information, and control gain is adjusted to the optimal control gain according to each of that detected condition.
[0048] Therefore, according to this invention, the optimal control gain can be set up in each control mode of an AC motor.
[0049] The rate-of-change judging section which judges more preferably whether the rate of change of a control means which detected the rate of the command change of potential, and was detected is smaller than the 1st reference value, The control gain controller which performs either of the 1st to 3rd gain adjustment based on the error detecting element which detects the error of a command electrical potential difference and output voltage, and the judgment result from the rate-of-change judging section and the error from an error detecting element, The control section which controls an electrical-potential-difference converter so that output voltage turns into a command electrical potential difference using the control gain adjusted by the control gain controller is included.
[0050] The error of the rate of the command change of potential, and a command electrical potential difference and the output voltage of an electrical-potential-difference converter is detected independently. And according to the rate of change and error which were detected, control gain is adjusted to the optimal control gain, and feedback control is carried out so that output voltage may be in agreement with a command electrical potential difference using the adjusted optimal control gain, so that output voltage may be made in agreement with a command electrical potential difference.
[0051] Therefore, even if output voltage shifts from a command electrical potential difference according to a certain factor, output voltage can be exactly made in agreement with a command electrical potential difference in each control mode of an AC motor according to this invention.
[0052] A mode detection means detects still more preferably the control mode from which a carrier frequency differs.
[0053] The control mode from which a carrier frequency differs is detected, and control gain is adjusted according to the detected control mode.
[0054] Therefore, even if the control mode of an AC motor changes between the control modes from which a carrier frequency differs, feedback control can be carried out so that output voltage may be in agreement with a command electrical potential difference.
[0055] A control means adjusts control gain still more preferably according to the carrier frequency of the detected control mode.
[0056] The control gain in feedback control is adjusted to the control gain suitable for the carrier frequency in the detected control mode.
[0057] Therefore, according to this invention, the output voltage of an electrical-potential-difference converter can be made in agreement with whether you are Sumiya on a command electrical potential difference.
[0058] Still more preferably, a control means adjusts control gain to larger control gain than control gain when a carrier frequency is low as the carrier frequency of the detected control mode becomes high.
[0059] The control gain in feedback control is adjusted so that hunting, overshoot, and undershooting may not arise.
[0060] Therefore, even if the control mode of an AC motor switches between the control modes from which a carrier frequency differs, the output voltage of an electrical-potential-difference converter can be made in

agreement with whether you are Sumiya on a command electrical potential difference according to this invention.
[0061] Still more preferably, a mode detection means detects two or more control modes corresponding to two or more AC motors, and a control means adjusts control gain according to two or more detected control modes.
[0062] Control gain is adjusted so that it may be suitable for the control mode of two or more AC motors. Therefore, also when the output voltage of an electrical-potential-difference converter is used for the drive of two or more AC motors, output voltage can be made smoothly in agreement with a command electrical potential difference according to this invention.
[0063] Still more preferably, a control means detects the power fluctuation in the feedback control for which it opts according to the combination of two or more detected control modes, and adjusts control gain according to the detected power fluctuation.
[0064] The power fluctuation in the feedback control produced when each control mode of two or more AC motors switches is detected. And control gain is adjusted by the detected power fluctuation.
[0065] Therefore, according to this invention, control gain can be adjusted so that the control mode of two or more whole AC motors may be suited.
[0066] Still more preferably, a control means enlarges the range of the cut of control gain, and adjusts control gain, so that the detected power fluctuation is large.
[0067] When the control mode of two or more AC motors switches, power is changed, and control gain is adjusted so that the power after the fluctuation may be suited.
[0068] Therefore, even if the control mode switches in two or more AC motors, the output voltage of an electrical-potential-difference converter can be made smoothly in agreement with a command electrical potential difference according to this invention.
[0069] Still more preferably, a mode detection means receives the rotational frequency of an AC motor, and the torque of an AC motor, and detects the control mode based on the rotational frequency and torque which were received.
[0070] The rotational frequency of an AC motor and the torque of an AC motor change with control modes of an AC motor. Therefore, the control mode of an AC motor is detected by the torque of an AC motor, and the rotational frequency of an AC motor.
[0071] Therefore, according to this invention, the control mode of two or more AC motors is correctly detectable.
[0072] Still more preferably, a mode detection means holds the map in which the relation between the rotational frequency of an AC motor and the torque of an AC motor is shown, and detects the control mode by detecting the field of the map on which the rotational frequency and torque which were received are included.
[0073] The control mode of each AC motor is detected with reference to the map in which the relation between torque and a rotational frequency is shown.
[0074] Therefore, according to this invention, the control mode of two or more AC motors is quickly detectable.
[0075] Control gain is the PI control gain in feedback control still more preferably.
[0076] The integral gain and proportional gain in feedback control are adjusted. Therefore, according to this invention, the output voltage of an electrical-potential-difference converter can be made correctly in agreement with a command electrical potential difference.
[0077] An AC motor is a motor for cars still more preferably. The output voltage of an electrical-potential-difference converter is used for the drive of the AC motor carried in a car.
[0078] Therefore, according to this invention, it is stabilized and the driving wheel of a car can be driven. According to this invention, furthermore, the electrical-potential-difference conversion approach The 1st step which is the electrical-potential-difference conversion approach of changing the direct current voltage from DC power supply into output voltage so that output voltage may turn into a command electrical potential difference, and detects output voltage, The error of a command electrical potential difference and output voltage, and the 2nd step which detects the rate of the command change of potential, The 3rd step which adjusts the control gain in the feedback control of output voltage based on rate of change and an error, and the 4th step which changes direct current voltage into output voltage so that output voltage may turn into a command electrical potential difference by the feedback control using the adjusted control gain are included.
[0079] Even if it changes output voltage, feedback control is carried out so that output voltage may be in agreement with a command electrical potential difference.

[0080] Therefore, according to this invention, it is stabilized and output voltage can be outputted. Preferably, the 1st step contains the 2nd substep which detects output voltage based on the 1st substep which detects the input voltage inputted into the electrical-potential-difference transducer which changes direct current voltage into output voltage, and the detected input voltage and the conversion ratio in an electrical-potential-difference transducer.
[0081] The input voltage to an electrical-potential-difference converter is detected, and the output voltage of an electrical-potential-difference converter is detected using the detected input voltage and a known transfer factor.
[0082] Therefore, according to this invention, to fluctuation of the input voltage to an electrical-potential-difference transducer, feedback control can be performed so that output voltage may be in agreement with a command electrical potential difference.
[0083] Preferably, the 1st step contains the 2nd substep which detects output voltage based on the 1st substep which detects the temperature of DC power supply and detects the input voltage inputted into the electrical-potential-difference transducer which changes direct current voltage into output voltage based on the detected temperature, the detected input voltage, and the conversion ratio in an electrical-potential-difference transducer.
[0084] The direct current voltage outputted by the temperature of DC power supply from DC power supply is called for. And the output voltage of an electrical-potential-difference converter is detected by the called-for direct current voltage, i.e., the input voltage of an electrical-potential-difference converter, and the transfer factor.
[0085] Therefore, according to this invention, even if it originates in the temperature change of DC power supply and changes the input voltage to an electrical-potential-difference transducer, feedback control can be performed so that output voltage may be in agreement with a command electrical potential difference.
[0086] In the 3rd step, the rate of the command change of potential is smaller than the 1st reference value more preferably. And control gain is lowered when the absolute value of the error of a command electrical potential difference and output voltage is larger than the 2nd reference value. More greatly [rate of change] than the 1st reference value, when an absolute value with error is larger than the 2nd reference value, control gain is raised. When [when rate of change is smaller than the 1st reference value] an absolute value with error is smaller than the 2nd reference value, Or more greatly [rate of change] than the 1st reference value, when an absolute value with error is smaller than the 2nd reference value, control gain is held.
[0087] It is detected by the error of the rate of the command change of potential, and a command electrical potential difference and the output voltage of an electrical-potential-difference transducer whether feedback control is in a hunting condition, an overshoot condition, and which condition of undershooting information, and control gain is adjusted according to each of that detected condition..
[0088] Therefore, according to this invention, even if it changes the output voltage of an electrical-potential-difference converter, the control gain for making output voltage in agreement with a command electrical potential difference can be set up exactly.
[0089] According to this invention, furthermore, the electrical-potential-difference conversion approach The 1st step which is the electrical-potential-difference conversion approach of changing the direct current voltage from DC power supply into output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, and detects the control mode of an AC motor, The 2nd step which adjusts the control gain in the feedback control of output voltage according to the detected control mode, and the 3rd step which changes direct current voltage into output voltage so that output voltage may turn into a command electrical potential difference by the feedback control using the adjusted control gain are included.
[0090] The control mode of an AC motor is detected and the control gain in feedback control is adjusted according to the detected control mode. And feedback control is carried out so that the output voltage of an electrical-potential-difference transducer may turn into a command electrical potential difference using the adjusted control gain.
[0091] Therefore, according to this invention, even if it changes the control mode of an AC motor, feedback control can be performed so that output voltage may be in agreement with a command electrical potential difference.
[0092] According to this invention, furthermore, the electrical-potential-difference conversion approach The 1st step which is the electrical-potential-difference conversion approach of changing the direct current voltage from DC power supply into output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference, and detects the control mode of an AC motor, The 2nd step adjusted to the suitable control gain for the control mode which had the control gain in the feedback

control of output voltage detected, The 3rd step which detects output voltage, and the error of a command electrical potential difference and output voltage and the 4th step which detects the rate of the command change of potential, The 5th step which adjusts suitable control gain to the optimal control gain based on the rate of change and error which were detected, and the 6th step which changes direct current voltage into output voltage so that output voltage may turn into a command electrical potential difference by the feedback control using the adjusted optimal control gain are included.

[0093] The control mode of an AC motor is detected and the control gain in the feedback control of the output voltage outputted from an electrical-potential-difference transducer is adjusted to the suitable control gain for the detected control mode. And fluctuation of output voltage is detected, according to fluctuation of the detected output voltage, suitable control gain is adjusted further and the control gain in feedback control is set as the optimal control gain. If it does so, feedback control will be performed so that output voltage may be in agreement with a command electrical potential difference using the optimal control gain.

[0094] Therefore, according to this invention, output voltage can be made in agreement with a command electrical potential difference to fluctuation of the control mode of an AC motor, or fluctuation of output voltage.

[0095] In the 5th step, the rate of the command change of potential is smaller than the 1st reference value preferably. And when the absolute value of the error of a command electrical potential difference and output voltage is larger than the 2nd reference value, suitable control gain is lowered and is adjusted to the optimal control gain. More greatly [rate of change] than the 1st reference value, when an absolute value with error is larger than the 2nd reference value, suitable control gain is raised and is adjusted to the optimal control gain. Smaller [rate of change] than the 1st reference value, when an absolute value with error is smaller than the 2nd reference value, or when [than the 1st reference value / when rate of change is larger] an absolute value with error is smaller than the 2nd reference value, suitable control gain is held and is adjusted to the optimal control gain.

[0096] Control gain is adjusted according to each control mode of a motor, at the time of the adjustment to the optimal suitable control gain from control gain, it is detected by the error of the rate of the command change of potential, and a command electrical potential difference and the output voltage of an electrical-potential-difference transducer whether feedback control is in a hunting condition, an overshoot condition, and which condition of undershooting information, and control gain is adjusted to the optimal control gain according to each of that detected condition.

[0097] Therefore, according to this invention, the optimal control gain can be set up in each control mode of an AC motor.

[0098] The control mode detected in the 1st step is the control mode from which a carrier frequency differs more preferably.

[0099] The control mode from which a carrier frequency differs is detected, and control gain is adjusted according to the detected control mode.

[0100] Therefore, even if the control mode of an AC motor changes between the control modes from which a carrier frequency differs, feedback control can be carried out so that output voltage may be in agreement with a command electrical potential difference.

[0101] Still more preferably, the control modes detected in the 1st step are two or more control modes over two or more AC motors, and control gain is adjusted according to two or more detected control modes in the 2nd step.

[0102] Control gain is adjusted so that it may be suitable for the control mode of two or more AC motors. Therefore, also when the output voltage of an electrical-potential-difference converter is used for the drive of two or more AC motors, output voltage can be made smoothly in agreement with a command electrical potential difference according to this invention.

[0103] In the 1st step, the control mode is detected still more preferably based on the rotational frequency and torque of an AC motor.

[0104] The rotational frequency of an AC motor and the torque of an AC motor change with control modes of an AC motor. Therefore, the control mode of an AC motor is detected by the torque of an AC motor, and the rotational frequency of an AC motor.

[0105] Therefore, according to this invention, the control mode of an AC motor is correctly detectable.

[0106] Control gain is the PI control gain in feedback control still more preferably.

[0107] The integral gain and proportional gain in feedback control are adjusted. Therefore, according to this invention, the output voltage of an electrical-potential-difference converter can be made correctly in agreement with a command electrical potential difference.

[0108] Furthermore, the record medium which recorded the program for making a computer perform control

of the electrical-potential-difference conversion which changes the direct current voltage from DC power supply into output voltage so that output voltage may turn into a command electrical potential difference according to this invention and in which computer read is possible The 1st step which detects output voltage, and the error of a command electrical potential difference and output voltage and the 2nd step which detects the rate of the command change of potential, The 3rd step which adjusts the control gain in the feedback control of output voltage based on rate of change and an error, It is the record medium which recorded the program for making a computer perform the 4th step which transforms direct current voltage to output voltage so that output voltage may turn into a command electrical potential difference by the feedback control using the adjusted control gain and in which computer read is possible.
[0109] If the program recorded on the record medium is executed by computer, fluctuation of output voltage will be detected and the control gain in the feedback control of output voltage will be adjusted according to fluctuation of the detected output voltage. And feedback control is performed so that output voltage may be in agreement with a command electrical potential difference using the adjusted control gain.
[0110] Therefore, according to this invention, it is controllable so that the stable output voltage is outputted.
[0111] Preferably, the 1st step contains the 2nd substep which detects output voltage based on the 1st substep which detects the input voltage inputted into the electrical-potential-difference transducer which changes direct current voltage into output voltage, and the detected input voltage and the conversion ratio in an electrical-potential-difference transducer.
[0112] If a program is executed by computer, the input voltage to an electrical-potential-difference converter will be detected, and the output voltage of an electrical-potential-difference converter will be detected using the detected input voltage and a known transfer factor.
[0113] Therefore, according to this invention, to fluctuation of the input voltage to an electrical-potential-difference transducer, feedback control can be performed so that output voltage may be in agreement with a command electrical potential difference.
[0114] The 1st step contains the 2nd substep which detects output voltage based on the 1st substep which detects the temperature of DC power supply and detects the input voltage inputted into the electrical-potential-difference transducer which changes direct current voltage into output voltage based on the detected temperature, the detected input voltage, and the conversion ratio in an electrical-potential-difference transducer more preferably.
[0115] If a program is executed by computer, the direct current voltage outputted by the temperature of DC power supply from DC power supply will be called for. And the output voltage of an electrical-potential-difference converter is detected by the called-for direct current voltage, i.e., the input voltage of an electrical-potential-difference converter, and the transfer factor.
[0116] Therefore, according to this invention, even if it originates in the temperature change of DC power supply and changes the input voltage to an electrical-potential-difference transducer, feedback control can be performed so that output voltage may be in agreement with a command electrical potential difference.
[0117] In the 3rd step, the rate of the command change of potential is smaller than the 1st reference value still more preferably. And when the absolute value of the error of a command electrical potential difference and output voltage is larger than the 2nd reference value, PI control gain is lowered. More greatly [rate of change] than the 1st reference value, when an absolute value with error is larger than the 2nd reference value, PI control gain is raised. When [when rate of change is smaller than the 1st reference value] an absolute value with error is smaller than the 2nd reference value, Or more greatly [rate of change] than the 1st reference value, when an absolute value with error is smaller than the 2nd reference value, PI control gain is held.
[0118] If a program is executed by computer, it will be detected by the error of the rate of the command change of potential, and a command electrical potential difference and the output voltage of an electrical-potential-difference transducer whether feedback control is in a hunting condition, an overshoot condition, and which condition of undershooting information, and control gain will be adjusted according to each of that detected condition.
[0119] Therefore, according to this invention, even if it changes the output voltage of an electrical-potential-difference converter, the control gain for making output voltage in agreement with a command electrical potential difference can be set up exactly.
[0120] Furthermore, the record medium which recorded the program for making a computer perform control of the electrical-potential-difference conversion which changes the direct current voltage from DC power supply into output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference according to this invention and in which computer read is possible The 1st step which detects the control mode of an AC motor, and the 2nd step which adjusts the control gain in the

feedback control of output voltage according to the detected control mode, It is the record medium which recorded the program for making a computer perform the 3rd step which changes direct current voltage into output voltage so that output voltage may turn into a command electrical potential difference by the feedback control using the adjusted control gain and in which computer read is possible.

[0121] If a program is executed by computer, the control mode of an AC motor will be detected and the control gain in feedback control will be adjusted according to the detected control mode. And feedback control is carried out so that the output voltage of an electrical-potential-difference transducer may turn into a command electrical potential difference using the adjusted control gain.

[0122] Therefore, according to this invention, even if it changes the control mode of an AC motor, feedback control can be performed so that output voltage may be in agreement with a command electrical potential difference.

[0123] Furthermore, the record medium which recorded the program for making a computer perform control of the electrical-potential-difference conversion which changes the direct current voltage from DC power supply into output voltage so that the output voltage for driving an AC motor may turn into a command electrical potential difference according to this invention and in which computer read is possible The 1st step which detects the control mode of an AC motor, and the 2nd step adjusted to the suitable control gain for the control mode which had the control gain in the feedback control of output voltage detected, The 3rd step which detects output voltage, and the error of a command electrical potential difference and output voltage and the 4th step which detects the rate of the command change of potential, The 5th step which adjusts suitable control gain to the optimal control gain based on the rate of change and error which were detected, It is the record medium which recorded the program for making a computer perform the 6th step which changes direct current voltage into output voltage so that output voltage may turn into a command electrical potential difference by the feedback control using the adjusted optimal control gain and in which computer read is possible.

[0124] If a program is executed by computer, the control mode of an AC motor will be detected and the control gain in the feedback control of the output voltage outputted from an electrical-potential-difference transducer will be adjusted to the suitable control gain for the detected control mode. And fluctuation of output voltage is detected, according to fluctuation of the detected output voltage, suitable control gain is adjusted further and the control gain in feedback control is set as the optimal control gain. If it does so, feedback control will be performed so that output voltage may be in agreement with a command electrical potential difference using the optimal control gain.

[0125] Therefore, according to this invention, output voltage can be made in agreement with a command electrical potential difference to fluctuation of the control mode of an AC motor, or fluctuation of output voltage.

[0126] In the 5th step, the rate of the command change of potential is smaller than the 1st reference value preferably. And when the absolute value of the error of a command electrical potential difference and output voltage is larger than the 2nd reference value, suitable control gain is lowered and is adjusted to the optimal control gain. More greatly [rate of change] than the 1st reference value, when an absolute value with error is larger than the 2nd reference value, suitable control gain is raised and is adjusted to the optimal control gain. Smaller [rate of change] than the 1st reference value, when an absolute value with error is smaller than the 2nd reference value, or when [than the 1st reference value / when rate of change is larger] an absolute value with error is smaller than the 2nd reference value, suitable control gain is held and is adjusted to the optimal control gain.

[0127] If a program is executed by computer, control gain will be adjusted according to each control mode of a motor. At the time of the adjustment to the optimal suitable control gain from control gain The rate of the command change of potential, It is detected by the error of a command electrical potential difference and the output voltage of an electrical-potential-difference transducer whether feedback control is in a hunting condition, an overshoot condition, and which condition of undershooting information, and control gain is adjusted to the optimal control gain according to each of that detected condition.

[0128] Therefore, according to this invention, the optimal control gain can be set up in each control mode of an AC motor.

[0129] The control mode detected in the 1st step is the control mode from which a carrier frequency differs more preferably.

[0130] If a program is executed by computer, the control mode from which a carrier frequency differs will be detected, and control gain will be adjusted according to the detected control mode.

[0131] Therefore, even if the control mode of an AC motor changes between the control modes from which a carrier frequency differs, feedback control can be carried out so that output voltage may be in agreement

with a command electrical potential difference.
[0132] Still more preferably, the control modes detected in the 1st step are two or more control modes over two or more AC motors, and control gain is adjusted according to two or more detected control modes in the 2nd step.
[0133] If a program is executed by computer, control gain will be adjusted so that it may be suitable for the control mode of two or more AC motors.
[0134] Therefore, also when the output voltage of an electrical-potential-difference converter is used for the drive of two or more AC motors, output voltage can be made smoothly in agreement with a command electrical potential difference according to this invention.
[0135] In the 1st step, the control mode is detected still more preferably based on the rotational frequency and torque of an AC motor.
[0136] The rotational frequency of an AC motor and the torque of an AC motor change with control modes of an AC motor. Therefore, if a program is executed by computer, the control mode of an AC motor will be detected by the torque of an AC motor, and the rotational frequency of an AC motor.
[0137] Therefore, according to this invention, the control mode of an AC motor is correctly detectable.
[0138] Control gain is the PI control gain in feedback control still more preferably.
[0139] If a program is executed by computer, the integral gain and proportional gain in feedback control will be adjusted.
[0140] Therefore, according to this invention, the output voltage of an electrical-potential-difference converter can be made correctly in agreement with a command electrical potential difference.
[0141]
[Embodiment of the Invention] It explains to a detail, referring to a drawing about the gestalt of operation of this invention. In addition, the same sign is given to the same or a considerable part among drawing, and the explanation is not repeated.
[0142] With reference to [gestalt 1 of operation] drawing 1 , motorised equipment 100 equipped with the electrical-potential-difference inverter by the gestalt 1 of implementation of this invention is equipped with DC power supply B, voltage sensors 10, 11, and 13, the system relays SR1 and SR2, capacitors C1 and C2, the pressure-up converter 12, an inverter 14, a current sensor 24, and a control unit 30. AC motor M1 is a drive motor for generating the torque for driving the driving wheel of a hybrid car or an electric vehicle. Or this motor may be made to be built into a hybrid car as a thing which operates as a motor to an engine, for example, can perform engine starting so that it may have the function of the generator driven with an engine.

[0143] The pressure-up converter 12 contains a reactor L1, NPN transistors Q1 and Q2, and diodes D1 and D2. a reactor L1 -- on the other hand, an edge is connected to power-source Rhine of DC power supply B, and an another side edge is connected between the midpoint of NPN transistor Q1 and NPN transistor Q2, i.e., the emitter of NPN transistor Q1, and the collector of NPN transistor Q2. NPN transistors Q1 and Q2 are connected to a serial between power-source Rhine and an earth line. And the collector of NPN transistor Q1 is connected to power-source Rhine, and the emitter of NPN transistor Q2 is connected to an earth line. Moreover, between the collector emitters of each NPN transistors Q1 and Q2, the diodes D1 and D2 which pass a current from an emitter side to a collector side are arranged.
[0144] An inverter 14 consists of U phase arm 15, V phase arm 16, and W phase arm 17. U phase arm 15, V phase arm 16, and W phase arm 17 are formed in juxtaposition between power-source Rhine and a ground.
[0145] U phase arm 15 consists of NPN transistors Q3 and Q4 by which the series connection was carried out, V phase arm 16 consists of NPN transistors Q5 and Q6 by which the series connection was carried out, and W phase arm 17 consists of NPN transistors Q7 and Q8 by which the series connection was carried out. Moreover, between the collector emitters of each NPN transistors Q3-Q8, the diodes D3-D8 which pass a current are connected to the collector side from the emitter side, respectively.
[0146] The midpoint of each phase arm is connected to each phase end of each phase coil of AC motor M1. That is, AC motor M1 is the permanent magnet motor of a three phase circuit, common connection of the end of three coils, U, V, and W phase, is made, it is constituted at the middle point, the other end of V phase coil is connected to the midpoint of NPN transistors Q5 and Q6, and the other end of W phase coil is connected to the midpoint of NPN transistors Q7 and Q8 for the other end of U phase coil at the midpoint of NPN transistors Q3 and Q4, respectively.
[0147] DC power supply B consist of rechargeable batteries, such as nickel hydrogen or a lithium ion. A voltage sensor 10 detects the electrical potential difference V1 outputted from DC power supply B, and outputs the detected electrical potential difference V1 to a control unit 30. The system relays SR1 and SR2 are turned on by the signal SE from a control unit 30. A capacitor C1 graduates the direct current voltage

supplied from DC power supply B, and supplies the graduated direct current voltage to the pressure-up converter 12.
[0148] The pressure-up converter 12 carries out the pressure up of the direct current voltage supplied from the capacitor C1, and supplies it to a capacitor C2. If Signal PWU is received from a control device 30, with Signal PWU, the pressure-up converter 12 will carry out the pressure up of the direct current voltage according to the period when NPN transistor Q2 was turned on, and, more specifically, will supply it to a capacitor C2. In this case, NPN transistor Q1 is turned off by Signal PWU. Moreover, if Signal PWD is received from a control device 30, the pressure-up converter 12 will lower the pressure of the direct current voltage supplied from the inverter 14 through the capacitor C2, and will charge DC power supply B.
[0149] A capacitor C2 graduates the direct current voltage from the pressure-up converter 12, and supplies the graduated direct current voltage to an inverter 14. A voltage sensor 13 is the electrical potential difference V2 (it is equivalent to the input voltage to an inverter 14.) of the both ends of a capacitor C2, i.e., the output voltage of the pressure-up converter 12. It is below the same. It detects and the detected output voltage V2 is outputted to a control unit 30.
[0150] If direct current voltage is supplied from a capacitor C2, an inverter 14 will change direct current voltage into alternating voltage based on the signal PWMI from a control unit 30, and will drive AC motor M1. This drives AC motor M1 so that the torque specified with the torque command value TR may be generated. Moreover, at the time of regenerative braking of the hybrid car or electric vehicle in which motorised equipment 100 was carried, an inverter 14 changes into direct current voltage the alternating voltage which AC motor M1 generated based on the signal PWMC from a control unit 30, and supplies the changed direct current voltage to the pressure-up converter 12 through a capacitor C2. In addition, with regenerative braking said here, it includes braking accompanied by a regeneration generation of electrical energy when there is foot-brake actuation by the driver who drives a hybrid car or an electric vehicle, and decelerating a car, carrying out a regeneration generation of electrical energy in turning off an accelerator pedal during transit, although a foot brake is not operated (or termination of acceleration).
[0151] A current sensor 24 detects the motor current MCRT which flows to AC motor M1, and outputs the detected motor current MCRT to a control unit 30.
[0152] The torque command value TR and the motor rotational frequency MRN as which the control unit 30 was inputted from ECU (Electrical Control Unit) prepared outside, It is based on the electrical potential difference V1 from a voltage sensor 10, the output voltage V2 from a voltage sensor 13, and the motor current MCRT from a current sensor 24. The signal PWMI for driving Signal PWU and the inverter 14 for driving the pressure-up converter 12 by the approach of mentioning later is generated, and the Signal PWU and Signal PWMI which were generated are outputted to the pressure-up converter 12 and an inverter 14, respectively.
[0153] Signal PWU is a signal for driving the pressure-up converter 12, when the pressure-up converter 12 changes the direct current voltage from a capacitor C1 into output voltage V2. And when the pressure-up converter 12 changes direct current voltage into output voltage V2, a control device 30 carries out feedback control of the output voltage V2, and generates the signal PWU for driving the pressure-up converter 12 so that output voltage V2 may become ordered electrical-potential-difference command Vdc_com. About the generation method of Signal PWU, it mentions later.
[0154] Moreover, if a hybrid car or an electric vehicle receives the signal which shows that it went into regenerative-braking mode from external ECU, a control device 30 will generate the signal PWMC for changing into direct current voltage the alternating voltage generated with AC motor M1, and will output it to an inverter 14. In this case, switching control of NPN transistors Q4, Q6, and Q8 of an inverter 14 is carried out by Signal PWMC. That is, when generating electricity with U phase of AC motor M1, NPN transistors Q6 and Q8 are turned on, when generating electricity with V phase, NPN transistors Q4 and Q8 are turned on, and when generating electricity with W phase, NPN transistors Q4 and Q6 are turned on. Thereby, an inverter 14 changes into direct current voltage the alternating voltage generated with AC motor M1, and supplies it to the pressure-up converter 12.
[0155] Furthermore, if a hybrid car or an electric vehicle receives the signal which shows that it went into regenerative-braking mode from external ECU, a control device 30 will generate the signal PWD for lowering the pressure of the direct current voltage supplied from the inverter 14, and will output the generated signal PWD to the pressure-up converter 12. Thereby, the pressure of the alternating voltage which AC motor M1 generated is changed and lowered by direct current voltage, and it is supplied to DC power supply B.
[0156] Furthermore, a control unit 30 generates the signal SE for turning on the system relays SR1 and SR2, and outputs it to the system relays SR1 and SR2.

[0157] Drawing 2 is the functional block diagram of a control device 30. With reference to drawing 2 , a control unit 30 includes the motor torque control means 301 and the electrical-potential-difference conversion control means 302. The motor torque control means 301 The torque command value TR, the output voltage V1 of DC power supply B, the motor current MCRT The signal PWU for turning on / turning off NPN transistors Q1 and Q2 of the pressure-up converter 12 by the approach of mentioning later based on the output voltage V2 of the motor engine speed MRN and the pressure-up converter 12 at the time of the drive of AC motor M1, The signal PWMI for turning on / turning off NPN transistors Q3-Q8 of an inverter 14 is generated, and the Signal PWU and Signal PWMI which were generated are outputted to the pressure-up converter 12 and an inverter 14, respectively.
[0158] If a hybrid car or an electric vehicle receives the signal RGE which shows that it went into regenerative-braking mode from external ECU at the time of regenerative braking, the electrical-potential-difference conversion control means 302 will generate the signal PWMC for changing into direct current voltage the alternating voltage which AC motor M1 generated, and will output it to an inverter 14.
[0159] Moreover, if Signal RGE is received from external ECU at the time of regenerative braking, the electrical-potential-difference conversion control means 302 will generate the signal PWD for lowering the pressure of the direct current voltage supplied from the inverter 14, and will output it to the pressure-up converter 12. Thus, since the pressure-up converter 12 can also drop an electrical potential difference with the signal PWD for lowering the pressure of direct current voltage, it has the function of a bidirectional converter.
[0160] Drawing 3 is the functional block diagram of the motor torque control means 301. With reference to drawing 3 , the motor torque control means 301 contains the phase voltage operation part 40 for motor control, the PWM signal transformation section 42 for inverters, the inverter input voltage command operation part 50, the feedback voltage command operation part 52, and the duty ratio transducer 54.
[0161] The phase voltage operation part 40 for motor control receives the output voltage V2 of the pressure-up converter 12, i.e., the input voltage to an inverter 14, from a voltage sensor 13, receives the motor current MCRT which flows to each phase of AC motor M1 from a current sensor 24, and receives the torque command value TR from Exterior ECU. And the phase voltage operation part 40 for motor control calculates the electrical potential difference impressed to the coil of each phase of AC motor M1 based on these signals inputted, and supplies the calculated result to the PWM signal transformation section 42 for inverters. The PWM signal transformation section 42 for inverters is based on the count result received from the phase voltage operation part 40 for motor control, generates the signal PWMI which actually turns on / turns off each NPN transistors Q3-Q8 of an inverter 14, and outputs the generated signal PWMI to each NPN transistors Q3-Q8 of an inverter 14.
[0162] Thereby, switching control of each NPN transistors Q3-Q8 is carried out, and they control the current passed to each phase of the alternating current motor M1 so that AC motor M1 may take out the ordered torque. Thus, a motorised current is controlled and the motor torque according to the torque command value TR is outputted.
[0163] On the other hand, the inverter input voltage command operation part 50 calculates based on the torque command value TR and the motor engine speed MRN, the optimum value (desired value), i.e., electrical-potential-difference command Vdc_com, of inverter input voltage, and outputs the calculated electrical-potential-difference command Vdc_com to the feedback voltage command operation part 52.
[0164] Based on the output voltage V2 of the pressure-up converter 12 from a voltage sensor 13, and electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, by the approach of mentioning later, the feedback voltage command operation part 52 calculates feedback voltage command Vdc_com_fb, and outputs the calculated feedback voltage command Vdc_com_fb to the duty ratio transducer 54.
[0165] The duty ratio transducer 54 calculates the duty ratio for setting the output voltage V2 from a voltage sensor 13 as feedback voltage command Vdc_com_fb from the feedback voltage command operation part 52 based on the battery voltage V1 from a voltage sensor 10, and feedback voltage command Vdc_com_fb from the feedback voltage command operation part 52, and generates the signal PWU for being based on the calculated duty ratio, and turning on / turning off NPN transistors Q1 and Q2 of the pressure-up converter 12. And the duty ratio transducer 54 outputs the generated signal PWU to NPN transistors Q1 and Q2 of the pressure-up converter 12.
[0166] In addition, since the power are recording in a reactor L1 becomes large by enlarging on-duty of NPN transistor Q2 of the pressure-up converter 12 bottom, the output of the high voltage can be obtained more. On the other hand, the electrical potential difference of power-source Rhine falls by enlarging on-duty of upper NPN transistor Q1. Then, it is controllable in the electrical potential difference of power-source

Rhine by controlling the duty ratio of NPN transistors Q1 and Q2 on the electrical potential difference of the arbitration more than the output voltage of DC power supply B.
[0167] With reference to drawing 4 , the feedback voltage command operation part 52 contains a subtractor 521, the rate-of-change judging section 522, the electrical-potential-difference error judging section 523, the PI control gain decision section 524, and the PI control machine 525. A subtractor 521 receives electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and the output voltage V2 from a voltage sensor 13, and subtracts output voltage V2 from electrical-potential-difference command Vdc_com. And a subtractor 521 is outputted to the rate-of-change judging section 522 and the PI control machine 525 by setting the subtracted result to error deltaVdc.
[0168] The rate-of-change judging section 522 receives electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and error deltaVdc from a subtractor 521, and detects the rate of change of electrical-potential-difference command Vdc_com. And the rate-of-change judging section 522 judges whether the rate of change of detected electrical-potential-difference command Vdc_com is smaller than a reference value STD 1, and outputs the judgment result and error deltaVdc to the electrical-potential-difference error judging section 523. In this case, if the rate-of-change judging section 522 has memorized past electrical-potential-difference command Vdc_com and electrical-potential-difference command Vdc_com is newly received, it will detect the rate of change of electrical-potential-difference command Vdc_com with reference to past electrical-potential-difference command Vdc_com. Moreover, the rate-of-change judging section 522 outputs the judgment result DE 1 to the electrical-potential-difference error judging section 523, when the rate of change of electrical-potential-difference command Vdc_com is smaller than a reference value STD 1, and when the rate of change of electrical-potential-difference command Vdc_com is larger than a reference value STD 1, it outputs the judgment result DE 2 to the electrical-potential-difference error judging section 523.
[0169] The electrical-potential-difference error judging section 523 calculates the absolute value of error deltaVdc received from the rate-of-change judging section 532, and judges whether the calculated absolute value |deltaVdc| is larger than a reference value STD 2. And the electrical-potential-difference error judging section 523 receives the judgment result DE 1 which shows that the rate of change of electrical-potential-difference command Vdc_com is smaller than a reference value STD 1 from the rate-of-change judging section 522, and generates the signal GDWN for absolute value |deltaVdc| to lower PI control gain, when larger than a reference value STD 2, and outputs it to the PI control gain decision section 524. Moreover, the electrical-potential-difference error judging section 523 receives the judgment result DE 1 from the rate-of-change judging section 522, and generates the signal GHLD for absolute value |deltaVdc| to hold PI control gain, when smaller than a reference value STD 2, and outputs it to the PI control gain decision section 524. Furthermore, the electrical-potential-difference error judging section 523 receives the judgment result DE 2 which shows that the rate of change of electrical-potential-difference command Vdc_com is larger than a reference value STD 1 from the rate-of-change judging section 522, and generates the signal GUP for absolute value |deltaVdc| to raise PI control gain, when larger than a reference value STD 2, and outputs it to the PI control gain decision section 524. Furthermore, the electrical-potential-difference error judging section 523 receives the judgment result DE 2 from the rate-of-change judging section 522, and generates the signal GHLD for absolute value |deltaVdc| to hold PI control gain, when smaller than a reference value STD 2, and outputs it to the PI control gain decision section 524.
[0170] Only a predetermined value will lower PI control gain and the PI control gain decision section 524 will output the lowered PI control gain to the PI control machine 525, if Signal GDWN is received from the electrical-potential-difference error judging section 523. In this case, as for the PI control gain decision section 524, only a predetermined value lowers both proportional gain and integral gain. Moreover, the PI control gain decision section 524 will output the PI control gain already used for feedback control to the PI control machine 525, without changing PI control gain, if Signal GHLD is received from the electrical-potential-difference error judging section 523. In this case, the PI control gain decision section 524 does not change both proportional gain and integral gain. Furthermore, only a predetermined value will raise PI control gain and the PI control gain decision section 524 will output the raised PI control gain to the PI control machine 525, if Signal GUP is received from the electrical-potential-difference error judging section 523. In this case, as for the PI control gain decision section 524, only a predetermined value raises both proportional gain and integral gain.
[0171] The PI control machine 525 calculates feedback voltage command Vdc_com_fb based on PI control gain and error deltaVdc received from the PI control gain decision section 524. The PI control machine 525 substitutes proportional gain PG, the integral gain IG, and error deltaVdc which were received from the PI control gain decision section 524 to a degree type, and, specifically, calculates feedback voltage command

Vdc_com_fb.
[0172]
[Equation 1]

$$Vdc\_com\_fb = PG \times \Delta Vdc + IG \times \Sigma \Delta Vdc \quad \cdots (1)$$

[0173] The duty ratio transducer 54 contains the duty ratio operation part 541 for converters, and the PWM signal transformation section 542 for converters. The duty ratio operation part 541 for converters calculates the duty ratio for setting the output voltage V2 from a voltage sensor 13 as feedback voltage command Vdc_com_fb based on the battery voltage V1 from a voltage sensor 10, and feedback voltage command Vdc_com_fb from the PI control machine 525. The PWM signal transformation section 542 for converters generates the signal PWU for being based on duty ratio from the duty ratio operation part 541 for converters, and turning on / turning off NPN transistors Q1 and Q2 of the pressure-up converter 12. And the PWM signal transformation section 542 for converters outputs the generated signal PWU to NPN transistors Q1 and Q2 of the pressure-up converter 12. And based on Signal PWU, ON/OFF of NPN transistors Q1 and Q2 of the pressure-up converter 12 are done. By this, the pressure-up converter 12 changes direct current voltage into output voltage V2 so that output voltage V2 may become electrical-potential-difference command Vdc_com.
[0174] Thus, if the torque command value TR is received from external ECU, the motor torque control means 301 of a control unit 30 will carry out feedback control of the electrical-potential-difference conversion in the pressure-up converter 12 from direct current voltage to output voltage V2 so that the output voltage V2 of the pressure-up converter 12 may become electrical-potential-difference command Vdc_com calculated based on the torque command value TR, and it will control an inverter 14 so that AC motor M1 generates the torque of the torque command value TR. Thereby, AC motor M1 generates the torque specified with the torque command value TR.
[0175] When neither the internal resistance of DC power supply B nor the reactor L1 of the pressure-up converter 12 carries out long term deterioration, if PI control gain is held to constant value, the output voltage V2 of the pressure-up converter 12 will be set as electrical-potential-difference command Vdc_com. However, if the internal resistance of DC power supply B or the reactor L1 of the pressure-up converter 12 changes, the output voltage V2 of the pressure-up converter 12 will shift from electrical-potential-difference command Vdc_com.
[0176] As mentioned above, in order that the feedback voltage command operation part 52 of the motor torque control means 301 may calculate error deltaVdc of electrical-potential-difference command Vdc_com and the output voltage V2 of the pressure-up converter 12, it is equivalent to detecting fluctuation of output voltage V2 to calculate error deltaVdc. That is, since a gap of the output voltage V2 from electrical-potential-difference command Vdc_com originates in fluctuation of output voltage V2 and is produced, the amount of fluctuation of output voltage V2 becomes equal to error deltaVdc which is the amount of gaps of the output voltage V2 from electrical-potential-difference command Vdc_com.
[0177] And in order to adjust PI control gain based on error deltaVdc and to calculate feedback voltage command Vdc_com_fb based on the adjusted PI control gain, feedback voltage command Vdc_com_fb is the electrical-potential-difference command for setting the changed output voltage V2 as electrical-potential-difference command Vdc_com, when output voltage V2 is changed by change of the internal resistance of DC power supply B, or change of the reactor L1 of the pressure-up converter 12. Therefore, as for NPN transistors Q1 and Q2 of the pressure-up converter 12, the pressure-up converter 12 changes direct current voltage into output voltage V2 so that, as for the calculated signal PWU, output voltage V2 may become electrical-potential-difference command Vdc_com, even if it changes output voltage V2 ON / by being turned off in consideration of fluctuation of output voltage V2 based on Signal PWU.
[0178] Thus, in this invention, it is characterized by detecting fluctuation of the output voltage V2 of the pressure-up converter 12, adjusting PI control gain based on fluctuation of that detected output voltage V2, and performing feedback control. Thereby, even when the internal resistance of DC power supply B or the reactor L1 of the pressure-up converter 12 changes, direct current voltage can be changed into output voltage V2 so that output voltage V2 may become electrical-potential-difference command Vdc_com.
[0179] In addition, since fluctuation of the output voltage V2 of the pressure-up converter 12 is produced by fluctuation of the internal resistance of DC power supply B as mentioned above, it is equivalent to adjusting PI control gain based on fluctuation of the internal resistance of DC power supply B to adjust PI control gain based on fluctuation of the output voltage V2 of the pressure-up converter 12.
[0180] With reference to drawing 5 , the actuation which controls the electrical-potential-difference conversion to output voltage V2 from the direct current voltage in the pressure-up converter 12 is explained.

A start of actuation inputs the initial value of PI control gain (step S1). Thereby, PI control gain is initialized. And the subtractor 521 of the feedback voltage command operation part 52 receives electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and receives the output voltage V2 of the pressure-up converter 12 from a voltage sensor 13. And a subtractor 521 subtracts output voltage V2 from electrical-potential-difference command Vdc_com, and calculates error deltaVdc (step S2).

[0181] Then, the rate-of-change judging section 522 receives electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and detects the rate of change of the received electrical-potential-difference command Vdc_com. And the rate-of-change judging section 522 judges whether the rate of change of detected electrical-potential-difference command Vdc_com is smaller than a reference value STD 1 (step S3), when the rate of change of electrical-potential-difference command Vdc_com is smaller than a reference value STD 1, it outputs the judgment result DE 1 and error deltaVdc to the electrical-potential-difference error judging section 523, and when the rate of change of electrical-potential-difference command Vdc_com is larger than a reference value STD 1, it outputs the judgment result DE 2 and error deltaVdc to the electrical-potential-difference error judging section 523.

[0182] It is equivalent to judging whether the control system which sets output voltage V2 as electrical-potential-difference command Vdc_com is the control mode with a small control input, and whether it is the control mode with a large control input to judge whether the rate of change of electrical-potential-difference command Vdc_com is smaller than a reference value STD 1. When the rate of change of electrical-potential-difference command Vdc_com is smaller than a reference value STD 1, the difference of electrical-potential-difference command Vdc_com and output voltage V2 becomes small relatively, and the control input for bringing output voltage V2 close to electrical-potential-difference command Vdc_com becomes small.

[0183] It is because the difference of electrical-potential-difference command Vdc_com and output voltage V2 becomes large relatively when the rate of change of electrical-potential-difference command Vdc_com is larger than a reference value STD 1, and the control input for bringing output voltage V2 close to electrical-potential-difference command Vdc_com becomes large on the other hand.

[0184] When the judgment result DE 1 and error deltaVdc are received from the conversion-rate judging section 522 (i.e., when judged with the rate of change of electrical-potential-difference command Vdc_com being smaller than a reference value STD 1 in step S3), the electrical-potential-difference error judging section 523 calculates absolute value |deltaVdc| of error deltaVdc, and judges whether the calculated absolute value |deltaVdc| is larger than a reference value STD 2 (step S4).

[0185] It is equivalent to output voltage V2 changing up and down focusing on electrical-potential-difference command Vdc_com which is desired value, i.e., output voltage V2 carrying out hunting (vibration), that absolute value |deltaVdc| of error deltaVdc is larger than a reference value STD 2. And this originates in PI control gain being large. Therefore, the electrical-potential-difference error judging section 523 judges with PI control gain having too large absolute value |deltaVdc|, when larger than a reference value STD 2, and oscillating the control system (being too high). Moreover, the amount of gaps of the electrical-potential-difference command Vdc_com and output voltage V2 that whose absolute value |deltaVdc| of error deltaVdc is smaller than a reference value STD 2 it is desired value is small, and it is equivalent to output voltage V2 not resulting in hunting (vibration). Therefore, it judges with absolute value |deltaVdc| not oscillating the electrical-potential-difference error judging section 523, when smaller than a reference value STD 2.

[0186] That absolute value |deltaVdc| of error deltaVdc is larger than a reference value STD 2 originates in that the internal resistance of DC power supply B became small, or the reactor L1 of the pressure-up converter 12 having become large, and it arises. Therefore, in step S4, it is equivalent to judging whether it originated in that the internal resistance of DC power supply B became small, or the reactor L1 of the pressure-up converter 12 having become large, and output voltage V2 was changed more sharply than a predetermined value to judge whether absolute value |deltaVdc| is larger than a reference value STD 2.

[0187] When absolute value |deltaVdc| judges with it being larger than a reference value STD 2 (i.e., when it judges with PI control gain oscillating by being too large (being too high)), the electrical-potential-difference error judging section 523 generates the signal GDWN for lowering PI control gain, and outputs it to the PI control gain decision section 524. Moreover, when absolute value |deltaVdc| judges with it being smaller than a reference value STD 2 (i.e., when it judges with the control system not oscillating), the electrical-potential-difference error judging section 523 generates the signal GHLD for holding the last PI control gain, and outputs it to the PI control gain decision section 524.

[0188] If the PI control gain decision section 524 receives Signal GDWN from the electrical-potential-

difference error judging section 523, only a predetermined value will lower the proportional gain of PI control gain, and integral gain (step S5). Generally the predetermined value when lowering this gain is determined in consideration of the load of the pressure-up converter 12 which changes direct current voltage into output voltage V2, although it is 5%.

[0189] Moreover, the PI control gain decision section 524 will set the proportional gain of PI control gain, and integral gain as the last value, if Signal GHLD is received from the electrical-potential-difference error judging section 523 (step S6). And the PI control gain decision section 524 outputs the determined PI control gain to the PI control machine 525.

[0190] On the other hand, when the judgment result DE 2 and error deltaVdc are received from the conversion-rate judging section 522 (i.e., when judged with the rate of change of electrical-potential-difference command Vdc_com being larger than a reference value STD 1 in step S3), the electrical-potential-difference error judging section 523 calculates absolute value |deltaVdc| of error deltaVdc, and judges whether the calculated absolute value |deltaVdc| is larger than a reference value STD 2 (step S7).

[0191] In this case, it is equivalent to flattery delay having arisen to electrical-potential-difference command Vdc_com that it is greatly shifted [V2] from electrical-potential-difference command Vdc_com whose output voltage V2 is desired value that absolute value |deltaVdc| of error deltaVdc is larger than a reference value STD 2, i.e., output voltage. And this originates in PI control gain being small. Therefore, the electrical-potential-difference error judging section 523 judges with PI control gain having too small absolute value |deltaVdc|, when larger than a reference value STD 2, and flattery (being too low) delay having produced the control system. Moreover, the amount of gaps of the electrical-potential-difference command Vdc_com and output voltage V2 that whose absolute value |deltaVdc| of error deltaVdc is smaller than a reference value STD 2 it is desired value is small, and it is equivalent to output voltage V2 not resulting in flattery delay to electrical-potential-difference command Vdc_com. Therefore, absolute value |deltaVdc| judges the electrical-potential-difference error judging section 523 as flattery delay having not arisen, when smaller than a reference value STD 2.

[0192] In this case, that absolute value |deltaVdc| of error deltaVdc is larger than a reference value STD 2 originates in that the internal resistance of DC power supply B became large, or the reactor L1 of the pressure-up converter 12 having become small, and it arises. Therefore, in step S7, it is equivalent to judging whether it originated in that the internal resistance of DC power supply B became large, or the reactor L1 of the pressure-up converter 12 having become small, and output voltage V2 was changed more sharply than a predetermined value to judge whether absolute value |deltaVdc| is larger than a reference value STD 2.

[0193] When absolute value |deltaVdc| judges with it being larger than a reference value STD 2 (i.e., when it judges with PI control gain being too small and flattery (being too low) delay having arisen), the electrical-potential-difference error judging section 523 generates the signal GUP for raising PI control gain, and outputs it to the PI control gain decision section 524. Moreover, when absolute value |deltaVdc| judges with it being smaller than a reference value STD 2 (i.e., when it judges with flattery delay having not arisen in a control system), the electrical-potential-difference error judging section 523 generates the signal GHLD for holding the last PI control gain, and outputs it to the PI control gain decision section 524.

[0194] If the PI control gain decision section 524 receives Signal GUP from the electrical-potential-difference error judging section 523, only a predetermined value will raise the proportional gain of PI control gain, and integral gain (step S8).

[0195] Moreover, the PI control gain decision section 524 will set the proportional gain of PI control gain, and integral gain as the last value, if Signal GHLD is received from the electrical-potential-difference error judging section 523 (step S6). And the PI control gain decision section 524 outputs the determined PI control gain to the PI control machine 525.

[0196] Then, the PI control machine 525 substitutes for the above-mentioned formula (1) PI control gain and error deltaVdc determined in steps S5, S6, and S8, calculates feedback voltage command Vdc_com_fb, and outputs the calculated feedback voltage command Vdc_com_fb to the duty ratio operation part 541 for converters of the duty ratio transducer 54 (step S9).

[0197] If it does so, the duty ratio operation part 541 for converters will calculate the duty ratio for setting the output voltage V2 from a voltage sensor 13 as feedback voltage command Vdc_com_fb based on feedback voltage command Vdc_com_fb and the battery voltage V1 from a voltage sensor 10 (step S10). And the PWM signal transformation section 542 for converters generates the signal PWU for being based on duty ratio from the duty ratio operation part 541 for converters, and turning on / turning off NPN transistors Q1 and Q2 of the pressure-up converter 12.

[0198] The PWM signal transformation section 542 for converters outputs the generated signal PWU to

NPN transistors Q1 and Q2 of the pressure-up converter 12 (step S11). And based on Signal PWU, ON/OFF of NPN transistors Q1 and Q2 of the pressure-up converter 12 are done, and they are controlled so that the output voltage V2 of the pressure-up converter 12 approaches electrical-potential-difference command Vdc_com.

[0199] Then, steps S2-S11 are performed repeatedly, and finally, the pressure-up converter 12 changes direct current voltage into output voltage V2 so that output voltage V2 may become electrical-potential-difference command Vdc_com.

[0200] Thus, in this invention, fluctuation of the output voltage V2 resulting from change of the internal resistance of DC power supply B or change of the reactor L1 of the pressure-up converter 12 is detected (step S4, S7 reference), and it is characterized by what (steps S5 and S6, S8 reference) PI control gain (proportional gain and integral gain) is adjusted for according to the variation of that detected output voltage V2.

[0201] And even if change of the internal resistance of DC power supply B or change of the reactor L1 of the pressure-up converter 12 arises by performing feedback control using the PI control gain adjusted according to the variation of output voltage V2, output voltage V2 can be set as electrical-potential-difference command Vdc_com.

[0202] Again, the actuation in motorised equipment 100 is explained with reference to drawing 1 . A control unit 30 generates Signal PWU and Signal PWMI for controlling the pressure-up converter 12 and an inverter 14 so that AC motor M1 generates the torque command value TR, and outputs them to the pressure-up converter 12 and an inverter 14, respectively while it will generate the signal SE for turning on the system relays SR1 and SR2 and will output it to the system relays SR1 and SR2, if the torque command value TR is inputted from external ECU.

[0203] And DC power supply B output direct current voltage, and the system relays SR1 and SR2 supply direct current voltage to a capacitor C1. A capacitor C1 graduates the supplied direct current voltage, and supplies the graduated direct current voltage to the pressure-up converter 12.

[0204] If it does so, according to the signal PWU from a control unit 30, ON/OFF of NPN transistors Q1 and Q2 of the pressure-up converter 12 will be done, they will change direct current voltage into output voltage V2, and will supply it to a capacitor C2. A voltage sensor 13 detects the output voltage V2 which is an electrical potential difference of the both ends of a capacitor C2, and outputs the detected output voltage V2 to a control unit 30.

[0205] As mentioned above, a control unit 30 calculates error deltaVdc of electrical-potential-difference command Vdc_com and output voltage V2, and adjusts PI control gain according to the calculated error deltaVdc. And a control device 30 performs feedback control using the adjusted PI control gain, generates the signal PWU which controls the electrical-potential-difference conversion to output voltage V2 from direct current voltage so that output voltage V2 becomes electrical-potential-difference command Vdc_com, and outputs it to the pressure-up converter 12. By this, the pressure-up converter 12 changes direct current voltage into output voltage V2 so that output voltage V2 may become electrical-potential-difference command Vdc_com.

[0206] A capacitor C2 graduates the direct current voltage supplied from the pressure-up converter 12, and supplies it to an inverter 14. According to the signal PWMI from a control device 30, it is turned off and an inverter 14 changes direct current voltage into alternating voltage, and NPN transistors Q3-Q8 of an inverter 14 pass predetermined alternating current to each phase of U phase of the alternating current motor M1, V phase, and W phase so that AC motor M1 may generate ON / torque specified with the torque command value TR. Thereby, AC motor M1 generates the torque specified with the torque command value TR.

[0207] When the hybrid car or electric vehicle in which motorised equipment 100 was carried becomes regenerative-braking mode, a control unit 30 receives the signal which shows that it became regenerative-braking mode from external ECU, generates Signal PWMC and Signal PWD, and outputs them to an inverter 14 and the pressure-up converter 12, respectively.

[0208] AC motor M1 generates alternating voltage, and supplies the generated alternating voltage to an inverter 14. And according to the signal PWMC from a control unit 30, an inverter 14 changes alternating voltage into direct current voltage, and supplies the changed direct current voltage to the pressure-up converter 12 through a capacitor C2.

[0209] The pressure-up converter 12 lowers the pressure of direct current voltage according to the signal PWD from a control unit 30, supplies it to DC power supply B, and charges DC power supply B.

[0210] Thus, it sets to motorised equipment 100. Even when the internal resistance of DC power supply B or the reactor L1 of the pressure-up converter 12 changes The direct current voltage from DC power supply B is changed into output voltage V2 so that the output voltage V2 of the pressure-up converter 12 may become

electrical-potential-difference command Vdc_com. The changed direct current voltage is supplied to an inverter 14 through a capacitor C2, and the alternating current motor M1 drives it so that the torque specified with the torque command value TR may be generated. Moreover, in regenerative-braking mode, motorised equipment 100 drives so that DC power supply B may be charged by the power which AC motor M1 generated.
[0211] In addition, in step S4 of the flow chart shown in drawing 5 , and S7, it is equivalent to detecting change of the internal resistance of DC power supply B used as the cause of changing output voltage V2, or change of the reactor L1 of the pressure-up converter 12 to detect fluctuation of output voltage V2.
[0212] Moreover, in this invention, the feedback voltage command operation part 52 and the duty ratio transducer 54 of the pressure-up converter 12 and a control device 30 constitute a "electrical-potential-difference inverter."
[0213] Furthermore, in this invention, the feedback voltage command operation part 52 and the duty ratio transducer 54 constitute the "control means" which controls the pressure-up converter 12 as an electrical-potential-difference transducer.
[0214] Furthermore, the electrical-potential-difference conversion approach by this invention is the electrical-potential-difference conversion approach of performing feedback control according to the flow chart shown in drawing 5 , and changing direct current voltage into output voltage V2.
[0215] Furthermore, feedback control in the feedback voltage command operation part 52 and the duty ratio transducer 54 is performed by CPU (Central Processing Unit) in fact, and CPU controls the electrical-potential-difference conversion to output voltage V2 from direct current voltage according to the flow chart which performs read-out and its read program from ROM (Read Only Memory), and shows a program equipped with each step of the flow chart shown in drawing 5 to drawing 5 . Therefore, ROM is equivalent to the record medium which recorded the program equipped with each step of the flow chart shown in drawing 5 and in which computer (CPU) read is possible.
[0216] According to the gestalt 1 of operation, since it has the control means which controls the electrical-potential-difference conversion to output voltage from direct current voltage so that the variation of the output voltage of a pressure-up converter may be detected, PI control gain may be adjusted according to the detected variation and output voltage may become an electrical-potential-difference command, an electrical-potential-difference inverter can set output voltage as an electrical-potential-difference command, even when the internal resistance of DC power supply or the reactor of a pressure-up converter ages.
[0217] With reference to [gestalt 2 of operation] drawing 6 , motorised equipment 100A equipped with the electrical-potential-difference inverter by the gestalt 2 of operation replaces the control unit 30 of motorised equipment 100 with control unit 30A, a voltage sensor 11 is added, and others are the same as motorised equipment 100.
[0218] A voltage sensor 11 detects the input voltage V3 to the pressure-up converter 12, and outputs the detected input voltage V3 to control unit 30A.
[0219] With reference to drawing 7 , control unit 30A replaces the motor torque control means 301 of a control unit 30 with motor torque control means 301A, and others are the same as a control unit 30.
[0220] Motor torque control means 301A generates Signal PWU based on the input voltage V3 to the pressure-up converter 12, and outputs the generated signal PWU to the pressure-up converter 12 so that it may mention later, while it generates Signal PWMI by the same approach as the motor torque control means 301 and outputs it to an inverter 14.
[0221] With reference to drawing 8 , motor torque control means 301A replaces the feedback voltage command operation part 52 of the motor torque control means 301 with feedback voltage command operation part 52A, and others are the same as the motor torque control means 301.
[0222] Feedback voltage command operation part 52A calculates feedback voltage command Vdc_com_fb based on electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and the converter input voltage V3 from a voltage sensor 11.
[0223] With reference to drawing 9 , feedback voltage command operation part 52A adds the output voltage generation section 526 to the feedback voltage command operation part 52, and others are the same as the feedback voltage command operation part 52. In addition, in feedback voltage command operation part 52A, the duty ratio operation part 541 for converters outputs the calculated duty ratio to the PWM signal transformation section 542 for converters, and the output voltage generation section 526.
[0224] The output voltage generation section 526 generates output voltage V2 based on the converter input voltage V3 from a voltage sensor 11, and the duty ratio from the duty ratio operation part 541 for converters, and outputs the generated output voltage V2 to a subtractor 521. Specifically, the output voltage generation section 526 generates output voltage V2 by calculating the product of the converter input voltage V3 and

ON duty ratio.
[0225] In addition, the output voltage generation section 526 receives the output voltage Vdc of the pressure-up converter 12 from a voltage sensor 13, and checks that the output voltage V2 which asked for the output voltage V2 for which it asked by calculating the product of the converter input voltage V3 and ON duty ratio by the operation as compared with the output voltage Vdc of the pressure-up converter 12 is in agreement with output voltage Vdc. However, it is not necessary to carry out by what is necessary's being just to perform this check once, and continuing.
[0226] After the output voltage generation section 526 generates output voltage V2, feedback control is performed so that output voltage V2 may become electrical-potential-difference command Vdc_com according to the actuation explained in the gestalt 1 of operation.
[0227] In the gestalt 2 of this operation, the input voltage V3 to the pressure-up converter 12 is detected, and since feedback control is performed so that the output voltage V2 calculated based on that detected input voltage V3 may become electrical-potential-difference command Vdc_com, the gap from electrical-potential-difference command Vdc_com of the output voltage V2 resulting from change of the internal resistance of DC power supply B will be amended.
[0228] With reference to drawing 10 , the control action of the electrical-potential-difference conversion in the gestalt 2 of operation is explained. The flow chart shown in drawing 10 inserts step S1a between step S1 of a flow chart and step S2 which are shown in drawing 5 , and others are the same as the flow chart shown in drawing 5 .
[0229] The output voltage generation section 526 generates output voltage V2 after step S1 by calculating the product of the converter input voltage V3 from a voltage sensor 11, and the duty ratio from the duty ratio operation part 541 for converters (step S1a). Then, as explained in the gestalt 1 of operation, step S2 - step S11 are performed. And step S1a - step S11 are repeatedly performed after step S11.
[0230] Thus, in the gestalt 2 of operation, fluctuation of the input voltage V3 resulting from change of the internal resistance of DC power supply B is detected by detecting the input voltage V3 to the pressure-up converter 12. And since it asks for output voltage V2 based on the detected input voltage V3, it is equivalent to detecting fluctuation of output voltage V2 to detect fluctuation of input voltage V3.
[0231] Others are the same as the gestalt 1 of operation. Since an electrical-potential-difference inverter is equipped with the control means which controls the electrical-potential-difference conversion to output voltage from direct current voltage so that PI-control gain may be adjusted according to the variation which detected the variation of the input voltage of a pressure-up converter, and detected and detected the variation of the output voltage of a pressure-up converter based on the variation of the detected input voltage and output voltage may become an electrical-potential-difference command, even when the internal resistance of DC power supply ages according to the gestalt 2 of operation, output voltage can set as an electrical-potential-difference command.
[0232] With reference to [gestalt 3 of operation] drawing 11 , motorised equipment 100B by the gestalt 3 of operation replaces the control unit 30 of motorised equipment 100 with control unit 30B, thermo-sensor 10A and a current sensor 25 are added, and others are the same as motorised equipment 100.
[0233] Thermo-sensor 10A detects the temperature TB of DC power supply B, and outputs the detected temperature TB to control unit 30B. A current sensor 25 detects the power-source current Ib of DC power supply B, and outputs the detected power-source current Ib to control unit 30B.
[0234] With reference to drawing 12 , control unit 30B replaces the motor torque control means 301 of a control unit 30 with motor torque control means 301B, and others are the same as a control unit 30.
[0235] Motor torque control means 301B detects fluctuation of the supply voltage of DC power supply B accompanying fluctuation of the internal resistance of DC power supply B, generates Signal PWU based on fluctuation of the detected supply voltage, and outputs the generated signal PWU to the pressure-up converter 12 so that it may mention later, while it generates Signal PWMI by the same approach as the motor torque control means 301.
[0236] With reference to drawing 13 , motor torque control means 301B replaces the feedback voltage command operation part 52 of the motor torque control means 301 with feedback voltage command operation part 52B, and others are the same as the motor torque control means 301.
[0237] Feedback voltage command operation part 52B calculates feedback voltage command Vdc_com_fb based on electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and the temperature TB from thermo-sensor 10A and the power-source current Ib from a current sensor 25, and outputs the calculated feedback voltage command Vdc_com_fb to the duty ratio transducer 54.
[0238] With reference to drawing 14 , feedback voltage command operation part 52B adds the output

voltage generation section 527 to the feedback voltage command operation part 52, and others are the same as the feedback voltage command operation part 52. In addition, the duty ratio operation part 541 for converters outputs the calculated duty ratio to the PWM signal transformation section 542 for converters, and the output voltage generation section 527.

[0239] The output voltage generation section 527 calculates the output voltage V2 of the pressure-up converter 12 based on the dc-battery temperature TB from thermo-sensor 10A, the power-source current Ib from a current sensor 25, and the duty ratio from the duty ratio operation part 541 for converters, and outputs the calculated output voltage V2 to a subtractor 521.

[0240] Generation of the output voltage V2 in the output voltage generation section 527 is explained. When supply voltage of Rb and DC power supply B is set [the electromotive force of DC power supply B] to Vb for the internal resistance of Vb0 and DC power supply B, supply voltage Vb is expressed by the degree type.

[0241]

[Equation 2]

$$Vb = Vb0 - IbRb \quad \cdots (2)$$

[0242] Internal resistance Rb has the relation shown in the temperature TB and drawing 13 of for example, DC power supply B. Therefore, the output voltage generation section 527 holds as a map the relation of the internal resistance Rb and temperature TB which are shown in drawing 15 , and asks for the internal resistance Rb of DC power supply B from the held map in response to the temperature TB from thermo-sensor 10A. and the electromotive force Vb0 -- beforehand -- a solution -- **** -- since it is, the output voltage generation section 527 calculates supply voltage Vb by substituting for a formula (2) electromotive force Vb0, the internal resistance Rb for which it asked, and the power-source current Ib from a current sensor 25.

[0243] And the output voltage generation section 527 calculates the product of input voltage V3 and duty ratio for the calculated supply voltage Vb as input voltage V3 of the pressure-up converter 12, generates the output voltage V2 of the pressure-up converter 12, and outputs the generated output voltage V2 to a subtractor 521.

[0244] In addition, it checks whether the output voltage V2 of the output voltage generation section 527 for which it asked by the approach which received the output voltage Vdc of the pressure-up converter 12 from the voltage sensor 13, and was mentioned above corresponds with output voltage Vdc. It is not necessary to carry out by what is necessary's being just to perform this check once, and continuing.

[0245] After the output voltage generation section 527 generates output voltage V2, feedback control is performed so that output voltage V2 may become electrical-potential-difference command Vdc_com according to the actuation explained in the gestalt 1 of operation.

[0246] In the gestalt 3 of this operation, the temperature TB of DC power supply B is detected, and it is based on that detected temperature TB. The internal resistance Rb of DC power supply B, And ask for supply voltage Vb and output voltage V2 is calculated for the supply voltage Vb for which it asked as input voltage V3 to the pressure-up converter 12. Since feedback control is performed so that the calculated output voltage V2 may become electrical-potential-difference command Vdc_com, the gap from electrical-potential-difference command Vdc_com of the output voltage V2 resulting from change of the internal resistance of DC power supply B will be amended.

[0247] With reference to drawing 16 , the control action of the electrical-potential-difference conversion in the gestalt 3 of operation is explained. The flow chart shown in drawing 16 inserts step S1b and S1c between step S1 of a flow chart and step S2 which are shown in drawing 5 , and others are the same as the flow chart shown in drawing 5 .

[0248] The output voltage generation section 527 detects the internal resistance Rb of DC power supply B after step S1 based on the temperature TB from thermo-sensor 10A (step S1b). And the output voltage generation section 527 asks for supply voltage Vb based on the power-source current Ib from a current sensor 25, the internal resistance Rb for which it asked in step S1b, and electromotive force Vb0, and generates output voltage V2 by calculating the product of input voltage V3 and the duty ratio from the duty ratio operation part 541 for converters for the supply voltage Vb for which it asked as input voltage V3 to the pressure-up converter 12 (step S1c). Then, as explained in the gestalt 1 of operation, step S2 - step S11 are performed. And step S1b - step S11 are repeatedly performed after step S11.

[0249] Thus, in the gestalt 3 of operation, fluctuation of the supply voltage Vb of DC power supply B resulting from change of the internal resistance of DC power supply B and fluctuation of input voltage V3 are detected by detecting the temperature TB of DC power supply B. And since it asks for output voltage V2

based on the detected input voltage V3, it is equivalent to detecting fluctuation of output voltage V2 to detect fluctuation of supply voltage Vb.

[0250] Others are the same as the gestalt 1 of operation. According to the gestalt 3 of operation, an electrical-potential-difference inverter detects the temperature of DC power supply. It is based on the detected temperature. The variation of the internal resistance of DC power supply, the variation of supply voltage, And detect the variation of the input voltage of a pressure-up converter, and the variation of the output voltage of a pressure-up converter is detected based on the variation of the detected input voltage. Since it has the control means which controls the electrical-potential-difference conversion to output voltage from direct current voltage so that PI control gain may be adjusted according to the detected variation and output voltage may become an electrical-potential-difference command, even when the temperature of DC power supply changes, output voltage can be set as an electrical-potential-difference command.

[0251] With reference to [gestalt 4 of operation] drawing 17 , motorised equipment 100C equipped with the electrical-potential-difference inverter by the gestalt 4 of operation replaces the control unit 30 of motorised equipment 100 with control unit 30C, and others are the same as motorised equipment 100.

[0252] With reference to drawing 18 , control unit 30C replaces the motor torque control means 301 of a control unit 30 with motor torque control means 301C, and others are the same as a control unit 30.

[0253] Motor torque control means 301C detects the control mode of AC motor M1, and generates Signal PWU based on the detected control mode. And motor torque control means 301C outputs the generated signal PWU to the pressure-up converter 12.

[0254] With reference to drawing 19 , motor torque control means 301C replaces the feedback voltage command operation part 52 of the motor torque control means 301 with feedback voltage command operation part 52C, and others are the same as the motor torque control means 301.

[0255] Feedback voltage command operation part 52C calculates feedback voltage command Vdc_com_fb based on electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and the torque command value TR from Outside ECU and the engine speed MRN of AC motor M1, and outputs the calculated feedback voltage command Vdc_com_fb to the duty ratio transducer 54. Based on the torque command value TR and the motor rotational frequency MRN, feedback voltage command operation part 52C detects the control mode of AC motor M1, and, more specifically, determines the PI control gain which suits the detected control mode. And in the feedback control using the determined PI control gain, feedback voltage command operation part 52C calculates feedback voltage command Vdc_com_fb for setting the output voltage V2 of the pressure-up converter 12 as electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, and outputs it to the duty ratio transducer 54.

[0256] With reference to drawing 20 , feedback voltage command operation part 52C contains the control mode judging section 520, a subtractor 521, the PI control gain decision section 524, and the PI control machine 525.

[0257] It is as having explained the subtractor 521 and the PI control machine 525 in the gestalt 1 of operation.

[0258] Based on the torque command value TR and the motor rotational frequency MRN from Outside ECU, the control mode judging section 520 judges the control mode of AC motor M1, and outputs the judgment result and error deltaVdc from a subtractor 521 to the PI control gain decision section 524.

[0259] More specifically, the control mode judging section 520 judges any of the PWM control mode, the overmodulation control mode, and the rectangle control mode the control mode of AC motor M1 is based on the torque command value TR and the motor rotational frequency MRN. And when it judges with the control mode of AC motor M1 being the PWM control mode, the control mode judging section 520 generates the signal SCM 1 which shows that the control mode of AC motor M1 is the PWM control mode, and outputs the signal SCM 1 and error deltaVdc from a subtractor 521 which were generated to the PI control gain decision section 524.

[0260] Moreover, when it judges with the control mode of AC motor M1 being the overmodulation control mode, the control mode judging section 520 generates the signal SCM 2 which shows that the control mode of AC motor M1 is the overmodulation control mode, and outputs the signal SCM 2 and error deltaVdc from a subtractor 521 which were generated to the PI control gain decision section 524.

[0261] Furthermore, when it judges with the control mode of AC motor M1 being the rectangle control mode, the control mode judging section 520 generates the signal SCM 3 which shows that the control mode of AC motor M1 is the rectangle control mode, and outputs the signal SCM 3 and error deltaVdc from a subtractor 521 which were generated to the PI control gain decision section 524.

[0262] With reference to drawing 21 , the judgment approach of the control mode of AC motor M1 in the

control mode judging section 520 is explained. Drawing 21 is drawing showing the relation between the torque T of AC motor M1, and the motor rotational frequency MRN.

[0263] If the predetermined rotational frequency of the torque T of AC motor M1 is fixed and a predetermined rotational frequency is exceeded, it will fall gradually with the increment in the motor rotational frequency MRN. A field RGN1 shows that the control mode of AC motor M1 is the PWM control mode, a field RGN2 shows that the control mode of AC motor M1 is the overmodulation control mode, and a field RGN3 shows that the control mode of AC motor M1 is the rectangle control mode.

[0264] The control mode judging section 520 will judge whether the torque command value TR and motor rotational frequency MRN which were received are contained to which field of fields RGN1-RGN3, if the torque command value TR and the motor rotational frequency MRN are received from Exterior ECU. And when the torque command value TR and the motor rotational frequency MRN are contained to a field RGN1, the control mode of AC motor M1 judges that the control mode judging section 520 is the PWM control mode, and it generates a signal SCM 1. Judge with the control mode of AC motor M1 being the overmodulation control mode, when the torque command value TR and the motor rotational frequency MRN are contained to a field RGN2, and a signal SCM 2 is generated. When the torque command value TR and the motor rotational frequency MRN are contained to a field RGN3, it judges with the control mode of AC motor M1 being the rectangle control mode, and a signal SCM 3 is generated.

[0265] Thus, the control mode judging section 520 detects either the PWM control mode, the overmodulation control mode and the rectangle control mode based on the torque command value TR and the motor rotational frequency MRN. In this case, the PWM control mode has the highest carrier frequency that turns on / turns off NPN transistors Q3-Q8 of an inverter 14 which drive AC motor M1, the overmodulation control mode has a next high carrier frequency, and the rectangle control mode has the lowest carrier frequency. Therefore, it is equivalent to detecting the control mode from which a carrier frequency differs based on the torque command value TR and the motor rotational frequency MRN to detect either the PWM control mode, the overmodulation control mode and the rectangle control mode based on the torque command value TR and the motor rotational frequency MRN.

[0266] In addition, if the control mode judging section 520 holds as a map the relation of the torque of a motor and the rotational frequency of a motor which are shown in drawing 21 and the torque command value TR and the motor rotational frequency MRN are received from Exterior ECU It searches in any of the fields RGN1-RGN3 shown in drawing 21 the torque command value TR and the motor rotational frequency MRN are contained, and judges any of the PWM control mode, the overmodulation control mode, and the rectangle control mode the control mode of AC motor M1 is.

[0267] Again, with reference to drawing 20 , the PI control gain decision section 524 receives error deltaVdc from the control mode judging section 520 as either of the signals SCM1-SCM3, determines the PI control gain suitable for each control mode based on the signals SCM1-SCM3 and error deltaVdc which were received, and outputs the determined PI control gain to the PI control machine 525.

[0268] The PI control machine 525 substitutes the PI control gain (proportional gain PG and integral gain IG) from the PI control gain decision section 524, and error deltaVdc from a subtractor 521 for a formula (1), calculates feedback voltage command Vdc_com_fb, and outputs the calculated feedback voltage command Vdc_com_fb to the duty ratio transducer 54.

[0269] Thus, in the gestalt 4 of operation, feedback voltage command operation part 52C detects the control mode of AC motor M1, determines the PI control gain which suited the detected control mode, and is characterized by calculating feedback voltage command Vdc_com_fb for setting output voltage V2 as electrical-potential-difference command Vdc_com using the determined PI control gain.

[0270] With reference to drawing 22 , the actuation which controls the electrical-potential-difference conversion to output voltage V2 from the direct current voltage in the pressure-up converter 12 according to the control mode of AC motor M1 is explained. If actuation starts, the PI control gain decision section 524 will set PI control gain as initial value (step S20). Specifically, the PI control gain decision section 524 sets up the PI control gain for the PWM control modes as initial value. And a subtractor 521 receives the output voltage V2 from a voltage sensor 13, and electrical-potential-difference command Vdc_com from the inverter input voltage command operation part 50, calculates the difference of electrical-potential-difference command Vdc_com and output voltage V2, and outputs error deltaVdc to the control mode judging section 520.

[0271] The control mode judging section 520 receives the motor rotational frequency MRN and the torque command value TR from Exterior ECU, and judges them by the approach by which the control mode of AC motor M1 mentioned above whether it was the PWM control mode based on the motor rotational frequency MRN and torque command value TR which were received (step S21).

[0272] In step S21, the control mode judging section 520 generates a signal SCM 1, when it judges with the control mode of AC motor M1 being the PWM control mode, and it outputs the signal SCM 1 and error deltaVdc from a subtractor 521 which were generated to the PI control gain decision section 524. And the PI control gain decision section 524 determines the PI control gain (proportional gain PG and integral gain IG) suitable for the PWM control mode based on the signal SCM 1 from the control mode judging section 520, and outputs the PI control gain and error deltaVdc which were determined to the PI control machine 525. The PI control gain decision section 524 sets proportional gain PG as 1.0, sets the integral gain IG as 0.1, and, more specifically, sets the PI control gain in the feedback control of the output voltage V2 from the pressure-up converter 12 as the PI control gain suitable for the PWM control mode (step S22).
[0273] On the other hand, in step S21, the control mode judging section 520 judges whether the control mode of AC motor M1 is the overmodulation control mode based on the motor rotational frequency MRN and the torque command value TR, when it judges with the control mode of AC motor M1 not being the PWM control mode (step S23).
[0274] And in step S23, when it judges with the control mode of AC motor M1 being the overmodulation control mode, the control mode judging section 520 generates a signal SCM 2, and outputs the signal SCM 2 and error deltaVdc from a subtractor 521 which were generated to the PI control gain decision section 524.
[0275] The PI control gain decision section 524 determines the PI control gain (proportional gain PG and integral gain IG) suitable for the overmodulation control mode based on the signal SCM 2 from the control mode judging section 520, and outputs the PI control gain and error deltaVdc which were determined to the PI control machine 525. The PI control gain decision section 524 sets proportional gain PG as 0.7, sets the integral gain IG as 0.07, and, more specifically, sets the PI control gain in the feedback control of the output voltage V2 from the pressure-up converter 12 as the PI control gain suitable for the overmodulation control mode (step S24).
[0276] On the other hand, when the control mode judging section 520 judges with the control mode of AC motor M1 not being the overmodulation control mode in step S23, based on the motor rotational frequency MRN and the torque command value TR, the control mode of AC motor M1 judges whether it is the rectangle control mode (step S25).
[0277] And in step S25, when it judges with the control mode of AC motor M1 being the rectangle control mode, the control mode judging section 520 generates a signal SCM 3, and outputs the signal SCM 3 and error deltaVdc from a subtractor 521 which were generated to the PI control gain decision section 524.
[0278] The PI control gain decision section 524 determines the PI control gain (proportional gain PG and integral gain IG) suitable for the rectangle control mode based on the signal SCM 3 from the control mode judging section 520, and outputs the PI control gain and error deltaVdc which were determined to the PI control machine 525. The PI control gain decision section 524 sets proportional gain PG as 0.5, sets the integral gain IG as 0.05, and, more specifically, sets the PI control gain in the feedback control of the output voltage V2 from the pressure-up converter 12 as the PI control gain suitable for the rectangle control mode (step S26).
[0279] On the other hand, in step S25, when it judges with the control mode of AC motor M1 not being the rectangle control mode, the control mode judging section 520 generates Signal HLD, and outputs it to the PI control gain 525. The PI control gain decision section 524 holds PI control gain (proportional gain PG and integral gain IG) based on the signal HLD from the control mode judging section 520 (step S27). That is, the PI control gain decision section 524 determines the initial value set up in step S20 as PI control gain.
[0280] In addition, setting up most greatly PI control gain (proportional gain PG and integral gain IG), when the control mode of AC motor M1 is the PWM control mode, and setting up lowest PI control gain (proportional gain PG and integral gain IG), when the control mode of AC motor M1 is the rectangle control mode is based on the following reason.
[0281] Since it has a carrier frequency with the highest PWM control mode among the PWM control mode, the overmodulation control mode, and the rectangle control mode, it has a carrier frequency with the next high overmodulation control mode and the rectangle control mode has the lowest carrier frequency, even if it sets up PI control gain highly in the PWM control mode, it is because hunting (vibration) or overshoot will be produced in the rectangle control mode to hunting (vibration) or overshoot not arising if PI control gain is not set up low.
[0282] The control mode of AC motor M1 Moreover, the PWM control mode, the overmodulation control mode, When it is not any of the rectangle control mode, either, that and the initial value of PI control gain is set up as PI control gain in the feedback control of the output voltage V2 of the pressure-up converter 12 When the control mode of AC motor M1 is not any of the PWM control mode, the overmodulation control mode, and the rectangle control mode, either, it is necessary to return the direct current voltage currently

supplied to the inverter 14 to DC power supply B through the pressure-up converter 12. It is because the direction which set the PI control gain in feedback control as the control gain suitable for the PWM control mode with the largest PI control gain can collect direct current voltage from an inverter 14 side to a DC-power-supply B side easily if it does so.

[0283] Step S9-S11 of the flow chart shown in drawing 5 are performed after either of steps S22, S24, S26, and S27. Then, return, steps S21-S27, and step S9-S11 are performed to step S21 repeatedly.

[0284] Thus, the control mode of AC motor M1 is detected, and feedback control of output voltage V2 is performed so that PI control gain may be determined according to the detected control mode and the output voltage V2 of the pressure-up converter 12 may be in agreement with electrical-potential-difference command Vdc_com.

[0285] In addition, it is equivalent to determining PI control gain according to a carrier frequency to determine PI control gain according to to determine PI control gain according to the control mode of AC motor M1, i.e., the PWM control mode, the overmodulation control mode, and the rectangle control mode, since the PWM control mode, the overmodulation control mode, and the rectangle control mode are the control modes from which a carrier frequency differs.

[0286] Although explained having performed feedback control so that the output voltage V2 of the pressure-up converter 12 might be detected and the detected output voltage V2 might become electrical-potential-difference command Vdc_com in the above In the gestalt 4 of operation, as explained in the gestalt 2 of operation, the input voltage V3 to the pressure-up converter 12 is detected. Feedback control may be carried out so that the output voltage V2 calculated based on the detected input voltage V3 and the transfer factor in the pressure-up converter 12 may become electrical-potential-difference command Vdc_com. In that case, step S1a of the flow chart shown in drawing 10 and actuation from which S2 change direct current voltage into output voltage V2 according to the flow chart inserted between step S20 of a flow chart and step S21 which are shown in drawing 22 are performed.

[0287] Moreover, in the gestalt 4 of operation, as explained in the gestalt 3 of operation, the temperature TB of DC power supply B is detected, and it asks for the internal resistance Rb and supply voltage Vb of DC power supply B based on the detected temperature TB, and output voltage V2 may be calculated as input voltage V3 to the pressure-up converter 12, and feedback control of the supply voltage Vb for which it asked may be carried out so that the calculated output voltage V2 may become electrical-potential-difference command Vdc_com. In that case, step S1b of the flow chart shown in drawing 16 , S1c, and actuation from which S2 change direct current voltage into output voltage V2 according to the flow chart inserted between step S20 of a flow chart and step S21 which are shown in drawing 22 are performed.

[0288] Furthermore, motorised equipment equipped with the electrical-potential-difference inverter by the gestalt 4 of operation may be motorised equipment 100D shown in drawing 23 . With reference to drawing 23 , motorised equipment 100D adds a current sensor 28 and an inverter 31 to motorised equipment 100, the control unit 30 of motorised equipment 100 is replaced with control unit 30D, and others are the same as motorised equipment 100.

[0289] In addition, a capacitor C2 receives the direct current voltage from the pressure-up converter 12 through nodes N1 and N2, graduates the received direct current voltage, and supplies it not only to the inverter 14 but to the inverter 31. Moreover, a current sensor 24 detects the motor current MCRT1, and outputs it to control unit 30D. Furthermore, an inverter 14 changes the direct current voltage from a capacitor C2 into alternating voltage based on the signal PWMI1 from control-device 30D, drives AC motor M1 and changes into direct current voltage the alternating voltage which AC motor M1 generated based on the signal PWMC1.

[0290] An inverter 31 consists of the same configuration as an inverter 14. And based on the signal PWMI2 from control-device 30D, an inverter 31 changes the direct current voltage from a capacitor C2 into alternating voltage, drives AC motor M2 and changes into direct current voltage the alternating voltage which AC motor M2 generated based on the signal PWMC2. A current sensor 28 detects the motor current MCRT2 which flows to each phase of AC motor M2, and outputs it to control unit 30D.

[0291] Control unit 30D receives the output voltage V1 from DC power supply B from a voltage sensor 10, receives the electrical potential difference V3 of the input side of the pressure-up converter 12 from a voltage sensor 11, receives the motor currents MCRT1 and MCRT2 from current sensors 24 and 28, respectively, receives the output voltage V2 (namely, input voltage to inverters 14 and 31) of the pressure-up converter 12 from a voltage sensor 13, and receives the torque command values TR1 and TR2 and the motor rotational frequencies MRN1 and MRN2 from Exterior ECU. And control unit 30D generates the signal PWMI1 for carrying out switching control of NPN transistors Q3-Q8 of an inverter 14, when an inverter 14 drives AC motor M1 by the approach mentioned above based on an electrical potential

difference V1, output voltage V2, the motor current MCRT1, the torque command value TR1, and the motor engine speed MRN1, and it outputs the generated signal PWMI1 to an inverter 14.
[0292] Moreover, control unit 30D generates the signal PWMI2 for carrying out switching control of NPN transistors Q3-Q8 of an inverter 31, when an inverter 31 drives AC motor M2 by the approach mentioned above based on an electrical potential difference V1, output voltage V2, the motor current MCRT2, the torque command value TR2, and the motor engine speed MRN2, and it outputs the generated signal PWMI2 to an inverter 31.
[0293] Furthermore, when, as for control-device 30D, inverters 14 or 31 drive AC motors M1 or M2, An electrical potential difference V1, output voltage V2, the motor current MCRT1 (or MCRT2), The signal PWU for carrying out switching control of NPN transistors Q1 and Q2 of the pressure-up converter 12 by the approach mentioned above based on the torque command value TR1 (or TR2) and the motor engine speed MRN1 (or MRN2) is generated, and it outputs to the pressure-up converter 12.
[0294] Furthermore, control unit 30D generates the signal PWMC2 for changing into direct current voltage the alternating voltage which the signal PWMC1 for changing into direct current voltage the alternating voltage which AC motor M1 generated at the time of regenerative braking, or AC motor M2 generated, and outputs the generated signal PWMC1 or signal PWMC2 to an inverter 14 or an inverter 31, respectively. In this case, control-device 30D generates the signal PWD which controls the pressure-up converter 12 to lower the pressure of the direct current voltage from inverters 14 or 31, and to charge DC power supply B, and outputs it to the pressure-up converter 12.
[0295] Furthermore, control unit 30D generates the signal SE for turning on the system relays SR1 and SR2, and outputs it to the system relays SR1 and SR2.
[0296] With reference to drawing 24 , control unit 30D contains motor torque control means 301D and electrical-potential-difference conversion control means 302D. Motor torque control means 301D generates a signal 1 and PWMI 2 based on the motor current 1 and MCRT 2, the torque command value 1 and TR 2, the motor rotational frequency 1 and MRN 2, an electrical potential difference V1, and output voltage V2, and outputs it to inverters 14 and 31, respectively. Moreover, based on an electrical potential difference V1, output voltage V2, the motor current MCRT1 (or MCRT2), the torque command value TR1 (or TR2), and the motor rotational frequency MRN1 (or MRN2), motor torque control means 301D generates Signal PWU, and outputs the generated signal PWU to the pressure-up converter 12.
[0297] If the hybrid car or electric vehicle in which motorised equipment 100D was carried receives the signal RGE which shows that it went into regenerative-braking mode from Exterior ECU, electrical-potential-difference conversion control means 302D will generate a signal 1 and PWMC 2 and Signal PWD, will output the generated signal 1 and PWMC 2 to inverters 14 and 31, respectively, and will output Signal PWD to the pressure-up converter 12.
[0298] With reference to drawing 25 , motor torque control means 301D replaces the feedback voltage command operation part 52 of the motor torque control means 301 with feedback voltage command operation part 52D, and others are the same as the motor torque control means 301.
[0299] The phase voltage operation part 40 for motor control calculates the electrical potential difference impressed to each phase of AC motor M1 based on the output voltage V2, the motor current MCRT1, and the torque command value TR1 of the pressure-up converter 12, and calculates the electrical potential difference impressed to each phase of AC motor M2 based on output voltage V2, the motor current MCRT2, and the torque command value TR2. And motor torque control means 301D outputs the electrical potential difference calculated AC motor M1 or for M2 to the PWM signal transformation section 42 for inverters.
[0300] If the electrical potential difference for AC-motor M1 is received from the phase voltage operation part 40 for motor control, the PWM signal transformation section 42 for inverters will generate a signal PWMI1 based on the received electrical potential difference, and will output it to an inverter 14. Moreover, if the electrical potential difference for AC-motor M2 is received from the phase voltage operation part 40 for motor control, the PWM signal transformation section 42 for inverters will generate a signal PWMI2 based on the received electrical potential difference, and will output it to an inverter 31.
[0301] The inverter input voltage command operation part 50 calculates electrical-potential-difference command Vdc_com based on the torque command value TR1 and the motor rotational frequency MRN1 (or the torque command value TR2 and the motor rotational frequency MRN2), and outputs the calculated electrical-potential-difference command Vdc_com to feedback voltage command operation part 52D.
[0302] Feedback voltage command operation part 52D detects the control mode of AC motor M1 based on the output voltage V2, electrical-potential-difference command Vdc_com, the motor rotational frequency MRN1, and the torque command value TR1 of the pressure-up converter 12, and detects the control mode of AC motor M2 based on output voltage V2, electrical-potential-difference command Vdc_com, the motor

rotational frequency MRN2, and the torque command value TR2. And feedback voltage command operation part 52D determines PI control gain according to the control mode of detected AC motors M1 and M2, calculates feedback voltage command Vdc_com_fb in feedback control using the determined PI control gain, and outputs it to the duty ratio transducer 54.

[0303] With reference to drawing 26 , feedback voltage command operation part 52D replaces the control mode judging section 520 of feedback voltage command operation part 52C with control mode judging section 520D, and others are the same as feedback voltage command operation part 52C.

[0304] The judgment approach of the control mode in control mode judging section 520D is explained. Control mode judging section 520D is detected by the approach which mentioned above the control mode of AC motor M1 based on the motor rotational frequency MRN1 and the torque command value TR1, and is detected by the approach which mentioned above the control mode of AC motor M2 based on the motor rotational frequency MRN2 and the torque command value TR2. And control mode judging section 520D judges the control mode over two AC motors M1 and the M2 whole based on the control mode of detected AC motors M1 and M2.

[0305] More specifically control mode judging section 520D The map of the torque of a motor and the rotational frequency of a motor which are shown in drawing 21 like the control mode judging section 520 is held. If the torque command value TR1 and the motor rotational frequency MRN1 (or the torque command value TR2 and the motor rotational frequency MRN2) are received from Exterior ECU It searches in any of the fields RGN1-RGN3 of a map the torque command value TR1 and motor rotational frequency MRN1 (or the torque command value TR2 and the motor rotational frequency MRN2) which were received are contained. It judges any of the PWM control mode, the overmodulation control mode, and the rectangle control mode the control mode of AC motor M1 (or AC motor M2) is.

[0306] In this case, the PWM control mode, the overmodulation control mode, and the rectangle control mode exist as the control mode of AC motor M1, and the PWM control mode, the overmodulation control mode, and the rectangle control mode exist as the control mode of AC motor M2. Therefore, as shown in Table 1 to two AC motors M1 and the M2 whole, the nine control modes may exist.

[0307]

[Table 1]

モータ1	モータ2	電力変動：ΔP	PI制御ゲイン
PWM電流制御＝ΔP：小	PWM電流制御＝ΔP：小	小＋小	1
	過変調制御＝ΔP：中	小＋中	2
	矩形制御＝ΔP：大	小＋大	3
過変調制御＝ΔP：中	PWM電流制御＝ΔP：小	中＋小	2
	過変調制御＝ΔP：中	中＋中	3
	矩形制御＝ΔP：大	中＋大	4
矩形制御＝ΔP：大	PWM電流制御＝ΔP：小	大＋小	3
	過変調制御＝ΔP：中	大＋中	4
	矩形制御＝ΔP：大	大＋大	5

[0308] In Table 1, "deltaP" expresses the power fluctuation in the pressure-up converter 12 at the time of changing PI control gain. And the PWM control mode has small power fluctuation deltaP, power fluctuation deltaP of the overmodulation control mode is inside, and power fluctuation deltaP is enlarging the rectangle control mode. As this was mentioned above, since the carrier frequency which follows on the control mode of AC motor M1 (or M2) switching to the PWM control mode, the overmodulation control mode, and the rectangle control mode one by one, and turns on / turns off NPN transistors Q1 and Q2 of the pressure-up converter 12 becomes low, the PWM control mode has smallest power fluctuation deltaP, power fluctuation deltaP of the overmodulation control mode is inside, and the rectangle control mode is because power fluctuation deltaP becomes the largest.

[0309] Since the PWM control mode, the overmodulation control mode, and the rectangle control mode may exist as the control mode of AC motor M2 when the control mode of AC motor M1 is the PWM control mode if it does so, when the control modes of AC motor M2 are the PWM control mode, the

overmodulation control mode, and the rectangle control mode, respectively, power fluctuation deltaP becomes "smallness + smallness", "the inside of smallness +", and "smallness + size", respectively.

[0310] Moreover, when the control mode of AC motor M1 is the overmodulation control mode and the control modes of AC motor M2 are the PWM control mode, the overmodulation control mode, and the rectangle control mode, respectively since the PWM control mode, the overmodulation control mode, and the rectangle control mode may exist as the control mode of AC motor M2, power fluctuation deltaP becomes "inside + smallness", "the inside of inside +", and "inside + size", respectively.

[0311] Furthermore, when the control mode of AC motor M1 is the rectangle control mode and the control modes of AC motor M2 are the PWM control mode, the overmodulation control mode, and the rectangle control mode, respectively since the PWM control mode, the overmodulation control mode, and the rectangle control mode may exist as the control mode of AC motor M2, power fluctuation deltaP becomes "size + smallness", "the inside of size +", and "size + size", respectively.

[0312] And control mode judging section 520D generates the signal which shows the control mode of two AC motors M1 and the M2 whole based on power fluctuation deltaP, and outputs the signal and error deltaVdc which were generated to the PI control gain decision section 524.

[0313] When the control mode of AC motor M1 and AC motor M2 is the PWM control mode, control mode judging section 520D generates a signal SCMD1, and, more specifically, outputs the signal SCMD1 and error deltaVdc which were generated to the PI control gain decision section 524.

[0314] Moreover, when the control mode of AC motor M1 is the PWM control mode and the control mode of AC motor M2 is the overmodulation control mode, or when the control mode of AC motor M1 is the overmodulation control mode and the control mode of AC motor M2 is the PWM control mode, control mode judging section 520D generates a signal SCMD2, and outputs the signal SCMD2 and error deltaVdc which were generated to the PI control gain decision section 524.

[0315] Furthermore, when the control mode of AC motor M1 of control mode judging section 520D is the PWM control mode and the control mode of AC motor M2 is the rectangle control mode, Or when the control mode of AC motor M1 and AC motor M2 is the overmodulation control mode, Or when the control mode of AC motor M1 is the rectangle control mode and the control mode of AC motor M2 is the PWM control mode, a signal SCMD3 is generated and the signal SCMD3 and error deltaVdc which were generated are outputted to the PI control gain decision section 524.

[0316] Furthermore, when the control mode of AC motor M1 is the overmodulation control mode and the control mode of AC motor M2 is the rectangle control mode, or when the control mode of AC motor M1 is the rectangle control mode and the control mode of AC motor M2 is the overmodulation control mode, control mode judging section 520D generates a signal SCMD4, and outputs the signal SCMD4 and error deltaVdc which were generated to the PI control gain decision section 524.

[0317] Furthermore, when the control mode of AC motor M1 and AC motor M2 is the rectangle control mode, control mode judging section 520D generates a signal SCMD5, and outputs the signal SCMD5 and error deltaVdc which were generated to the PI control gain decision section 524.

[0318] The PI control gain decision section 524 changes PI control gain (proportional gain PG and integral gain IG) according to the signals SCMD1-SCMD5 received from control mode judging section 520D, and determines the PI control gain used for the feedback control of output voltage V2.

[0319] The PI control gain decision section 524 will make the smallest the range of the cut of PI control gain, if a signal SCMD1 is received from control mode judging section 520D, and if a signal SCMD5 is received from control mode judging section 520D, more specifically, it will determine the PI control gain which enlarges most the range of the cut of PI control gain, and is used for the feedback control of output voltage V2. Therefore, the figure indicated by the column of the PI control gain in Table 1 means that the range of the cut of PI control gain becomes large toward "1" -> "5."

[0320] And the PI control gain decision section 524 outputs the PI control gain determined as error deltaVdc to the PI control machine 525, and the PI control machine 525 substitutes PI control gain (proportional gain PG and integral gain IG) and error deltaVdc for a formula (1), calculates feedback voltage command Vdc_com_fb, and it outputs it to the duty ratio transducer 54.

[0321] With reference to drawing 27 , the actuation which controls the electrical-potential-difference conversion to output voltage V2 from the direct current voltage in the pressure-up converter 12 according to the control mode of AC motors M1 and M2 is explained.

[0322] If actuation starts, the PI control gain decision section 524 will set PI control gain as initial value (step S30). In this case, the PI control gain decision section 524 sets up the PI control gain for the PWM control modes as initial value. And a subtractor 521 receives the output voltage V2 from a voltage sensor 13, and electrical-potential-difference command Vdc_com from the inverter input voltage command operation

part 50, calculates the difference of electrical-potential-difference command Vdc_com and output voltage V2, and outputs error deltaVdc to control mode judging section 520D.

[0323] Control mode judging section 520D receives the motor rotational frequency 1 and MRN 2 and the torque command value 1 and TR 2 from Exterior ECU. Based on the motor rotational frequency 1 and MRN 2 and torque command value TR 1 and 2 which were received, each control mode of AC motors M1 and M2 is detected (step S31). Based on the control mode of the detected AC motors M1 and M2, the signal (either of the signals SCMD1-SCMD5) which shows the control mode of two AC motors M1 and the M2 whole is generated, and it outputs to the PI control gain decision section 524.

[0324] The PI control gain decision section 524 is determined by the approach which mentioned above the PI control gain corresponding to the signals SCMD1-SCMD5 from control mode judging section 520D (step S32).

[0325] In addition, in step S31, control mode judging section 520D detects the control mode of AC motors M1 and M2 by the more specifically same actuation as the actuation in steps S21, S23, and S25 of the flow chart shown in drawing 22 .

[0326] Step S9-S11 mentioned above are performed after step S32, and according to the control mode of two AC motors M1 and the M2 whole, feedback control of the output voltage V2 of the pressure-up converter 12 is carried out so that it may be in agreement with electrical-potential-difference command Vdc_com.

[0327] Then, return, steps S31-S32, and step S9-S11 are performed to step S31 repeatedly.

[0328] In addition, control mode judging section 520D may judge the control mode of the large motor of output capacity to be the control mode of two AC motors M1 and the M2 whole, when the output capacity of AC motors M1 and M2 differs mutually.

[0329] Moreover, in motorised equipment 100D, as explained in the gestalt 2 of operation, the input voltage V3 to the pressure-up converter 12 may be detected, and feedback control may be carried out so that the output voltage V2 calculated based on the detected input voltage V3 and the transfer factor in the pressure-up converter 12 may become electrical-potential-difference command Vdc_com. In that case, step S1a of the flow chart shown in drawing 10 and actuation from which S2 change direct current voltage into output voltage V2 according to the flow chart inserted between step S30 of a flow chart and step S31 which are shown in drawing 27 are performed.

[0330] Furthermore, in motorised equipment 100D, as explained in the gestalt 3 of operation, the temperature TB of DC power supply B is detected, and it asks for the internal resistance Rb and supply voltage Vb of DC power supply B based on the detected temperature TB, and output voltage V2 may be calculated as input voltage V3 to the pressure-up converter 12, and feedback control of the supply voltage Vb for which it asked may be carried out so that the calculated output voltage V2 may become electrical-potential-difference command Vdc_com. In that case, step S1b of the flow chart shown in drawing 16 , S1c, and actuation from which S2 change direct current voltage into output voltage V2 according to the flow chart inserted between step S30 of a flow chart and step S31 which are shown in drawing 27 are performed.

[0331] Furthermore, in motorised equipment 100D, the motor which should be driven may be not only two pieces but three pieces or more.

[0332] Even when the control mode of a motor changes since it has the control means which controls the electrical-potential-difference conversion to output voltage from direct current voltage so that according to the gestalt 4 of operation an electrical-potential-difference inverter may detect the control mode of a motor, the PI control gain which suits the detected control mode may be determined as the PI control gain of feedback control and output voltage may become an electrical-potential-difference command, direct current voltage can be stabilized and changed into output voltage so that output voltage may become an electrical-potential-difference command.

[0333] With reference to [gestalt 5 of operation] drawing 28 , motorised equipment 100E equipped with the electrical-potential-difference inverter by the gestalt 5 of operation replaces the control unit 30 of motorised equipment 100 with control unit 30E, and others are the same as motorised equipment 100.

[0334] With reference to drawing 29 , control unit 30E replaces the motor torque control means 301 of a control unit 30 with motor torque control means 301E, and others are the same as a control unit 30.

[0335] Motor torque control means 301E generates Signal PWMI based on the output voltage V2 of the motor current MCRT, the torque command value TR, and the pressure-up converter 12, and outputs it to an inverter 14. Moreover, motor torque control means 301E detects the control mode of AC motor M1 based on the motor rotational frequency MRN and the torque command value TR. According to the control mode of the detected AC motor M1, the PI control gain in the feedback control of output voltage V2 is determined. And the determined PI control gain is adjusted to fluctuation of output voltage V2, the signal

PWU for changing direct current voltage into output voltage V2 so that output voltage V2 may be in agreement with electrical-potential-difference command Vdc_com is generated, and it outputs to a converter 12.
[0336] With reference to drawing 30 , motor torque control means 301E replaces the feedback voltage command operation part 52 of the motor torque control means 301 with feedback voltage command operation part 52E, and others are the same as the motor torque control means 301.
[0337] Feedback voltage command operation part 52E is detected by the approach (gestalt 4 reference of operation) which mentioned above the control mode of AC motor M1 based on the motor rotational frequency MRN and the torque command value TR. According to the detected control mode, PI control gain (proportional gain PG and integral gain IG) is determined. And the determined PI control gain is adjusted according to fluctuation of output voltage V2, final PI control gain is determined, feedback voltage command Vdc_com_fb is calculated using the final PI control gain, and it outputs to the duty ratio transducer 54.
[0338] With reference to drawing 31 , feedback voltage command operation part 52E contains the control mode judging section 520, a subtractor 521, the rate-of-change decision section 522, the electrical-potential-difference error judging section 523, PI control gain decision section 524A, and the PI control machine 525.
[0339] It is as having mentioned above about the control mode judging section 520, a subtractor 521, the rate-of-change decision section 522, the electrical-potential-difference error judging section 523, and the PI control machine 525.
[0340] PI control gain decision section 524A determines the PI control gain according to the control mode of AC motor M1 based on the signal (either of the signals SCM1-SCM3) which shows the control mode of AC motor M1 from the control mode judging section 520, and adjusts the determined PI control gain according to the signal GUP from the electrical-potential-difference error judging section 523, GHLD, and GDWN, and determines final PI control gain. And PI control gain decision section 524A outputs the determined final PI control gain to the PI control machine 525.
[0341] Thus, PI control gain decision section 524A is characterized by determining the PI control gain according to the control mode of AC motor M1, adjusting the determined PI control gain further to fluctuation of output voltage V2, and determining final PI control gain.
[0342] In addition, it is referred to as "Adjusting to the suitable control gain for the control mode of an AC motor" to determine PI control gain according to the control mode of AC motor M1, and it is referred to as "Adjusting suitable control gain to the optimal control gain based on fluctuation of output voltage V2" to adjust further the PI control gain determined according to the control mode to fluctuation of output voltage V2.
[0343] In the gestalt 5 of operation, actuation which controls the electrical-potential-difference conversion to output voltage V2 from the direct current voltage in the pressure-up converter 12 is performed according to the flow chart shown in drawing 32 .
[0344] The flow chart shown in drawing 32 is a flow chart which added steps S2-S11 of the flow chart shown in drawing 5 to steps S20-S27 of the flow chart shown in drawing 22 .
[0345] The actuation performed with reference to drawing 32 according to steps S21-S27 is actuation which detects the control mode of AC motor M1 based on the motor rotational frequency MRN and the torque command value TR. Moreover, the actuation performed according to steps S2-S11 is actuation controlled so that PI control gain is adjusted to fluctuation of output voltage V2 and output voltage V2 becomes electrical-potential-difference command Vdc_com.
[0346] Therefore, the detailed actuation in steps S20-S27 and steps S2-S11 is as having mentioned above.
[0347] Return, steps S21-S27, and steps S2-S11 are performed after step S11 to step S21.
[0348] Although explained having performed feedback control so that the output voltage V2 of the pressure-up converter 12 might be detected and the detected output voltage V2 might become electrical-potential-difference command Vdc_com in the above In the gestalt 5 of operation, as explained in the gestalt 2 of operation, the input voltage V3 to the pressure-up converter 12 is detected. Feedback control may be carried out so that the output voltage V2 calculated based on the detected input voltage V3 and the transfer factor in the pressure-up converter 12 may become electrical-potential-difference command Vdc_com. In that case, actuation whose step S1a of the flow chart shown in drawing 10 changes direct current voltage into output voltage V2 according to the flow chart inserted between steps S22, S24, S26, and S27 of a flow chart and step S2 which are shown in drawing 32 is performed.
[0349] Moreover, in the gestalt 5 of operation, as explained in the gestalt 3 of operation, the temperature TB of DC power supply B is detected, and it asks for the internal resistance Rb and supply voltage Vb of DC power supply B based on the detected temperature TB, and output voltage V2 may be calculated as input

voltage V3 to the pressure-up converter 12, and feedback control of the supply voltage Vb for which it asked may be carried out so that the calculated output voltage V2 may become electrical-potential-difference command Vdc_com. In that case, actuation whose step S1b of the flow chart shown in drawing 16 and S1c change direct current voltage into output voltage V2 according to the flow chart inserted between steps S22, S24, S26, and S27 of a flow chart and step S2 which are shown in drawing 32 is performed.
[0350] Furthermore, PI control gain is determined according to the control mode of each motor, and you may make it adjust the determined PI control gain further to fluctuation of the output voltage of the pressure-up converter 12 to two or more motors, as explained in the gestalt 4 of operation. In that case, steps S31 and S32 of the flow chart which replaces with steps S21-S27 of the flow chart shown in drawing 32 , and is shown in drawing 27 are performed.
[0351] According to the gestalt 5 of operation, an electrical-potential-difference inverter determines the PI control gain according to the control mode of a motor, adjusts the determined PI control gain further according to fluctuation of output voltage, and since it is equipped with the control means which carries out feedback control of the conversion to output voltage from direct current voltage so that output voltage may be in agreement with an electrical-potential-difference command, it can stabilize output voltage to fluctuation of the control mode of a motor, or fluctuation of the output voltage of a pressure-up converter.
[0352] In addition, in the gestalten 1-5 of operation, although the feedback control by PI control was explained, feedback control by PID control may be performed in this invention. In that case, it is adjusted by the approach which PID-control gain (proportional gain PG, the integral gain IG, rate-gain DG) mentioned above, and feedback control is carried out so that output voltage V2 may be in agreement with electrical-potential-difference command Vdc_com.
[0353] Moreover, in this invention, the "error" used in the above may be expressed as "deflection."
[0354] It should be thought that the gestalt of the operation indicated this time is [no] instantiation at points, and restrictive. The range of this invention is shown by the above-mentioned not explanation but claim of the gestalt of operation, and it is meant that all modification in a claim, equal semantics, and within the limits is included.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline block diagram of motorised equipment equipped with the electrical-potential-difference inverter by the gestalt 1 of operation.
[Drawing 2] It is the functional block diagram of the control device shown in drawing 1 .
[Drawing 3] It is a functional block diagram for explaining the function of the motor torque control means shown in drawing 2 .
[Drawing 4] It is a functional block diagram for explaining the function of the feedback voltage command operation part shown in drawing 3 , and a duty ratio transducer.
[Drawing 5] It is a flow chart for explaining the control action of the electrical-potential-difference conversion in the gestalt 1 of operation.
[Drawing 6] It is the outline block diagram of motorised equipment equipped with the electrical-potential-difference inverter by the gestalt 2 of operation.
[Drawing 7] It is the functional block diagram of the control device shown in drawing 6 .
[Drawing 8] It is a functional block diagram for explaining the function of the motor torque control means shown in drawing 7 .
[Drawing 9] It is a functional block diagram for explaining the function of the feedback voltage command operation part shown in drawing 8 , and a duty ratio transducer.
[Drawing 10] It is a flow chart for explaining the control action of the electrical-potential-difference conversion in the gestalt 2 of operation.
[Drawing 11] It is the outline block diagram of motorised equipment equipped with the electrical-potential-difference inverter by the gestalt 3 of operation.
[Drawing 12] It is the functional block diagram of the control device shown in drawing 11 .
[Drawing 13] It is a functional block diagram for explaining the function of the motor torque control means shown in drawing 12 .
[Drawing 14] It is a functional block diagram for explaining the function of the feedback voltage command operation part shown in drawing 13 , and a duty ratio transducer.
[Drawing 15] It is the related Fig. of the internal resistance of DC power supply, and temperature.
[Drawing 16] It is a flow chart for explaining the control action of the electrical-potential-difference conversion in the gestalt 3 of operation.
[Drawing 17] It is the outline block diagram of motorised equipment equipped with the electrical-potential-difference inverter by the gestalt 4 of operation.
[Drawing 18] It is the functional block diagram of the control device shown in drawing 17 .
[Drawing 19] It is a functional block diagram for explaining the function of the motor torque control means shown in drawing 18 .
[Drawing 20] It is a functional block diagram for explaining the function of feedback voltage command operation part shown in drawing 19 .
[Drawing 21] It is the related Fig. of the torque of a motor, and a motor rotational frequency.
[Drawing 22] It is a flow chart for explaining the control action of the electrical-potential-difference conversion in the gestalt 4 of operation.
[Drawing 23] They are other outline block diagrams of motorised equipment equipped with the electrical-potential-difference inverter by the gestalt 4 of operation.
[Drawing 24] It is the functional block diagram of the control device shown in drawing 23 .
[Drawing 25] It is a functional block diagram for explaining the function of the motor torque control means shown in drawing 24 .
[Drawing 26] It is a functional block diagram for explaining the function of feedback voltage command

operation part shown in drawing 25 .
[Drawing 27] It is a flow chart for explaining other control action of the electrical-potential-difference conversion in the gestalt 4 of operation.
[Drawing 28] It is the outline block diagram of motorised equipment equipped with the electrical-potential-difference inverter by the gestalt 5 of operation.
[Drawing 29] It is the functional block diagram of the control device shown in drawing 28 .
[Drawing 30] It is a functional block diagram for explaining the function of the motor torque control means shown in drawing 29 .
[Drawing 31] It is a functional block diagram for explaining the function of feedback voltage command operation part shown in drawing 30 .
[Drawing 32] It is a flow chart for explaining the control action of the electrical-potential-difference conversion in the gestalt 5 of operation.
[Drawing 33] It is the outline block diagram of conventional motorised equipment.
[Description of Notations]
10, 11, 13,320 A voltage sensor, 10A Thermo sensor, 12 14 A pressure-up converter, 31,330 An inverter, 15 U phase arm, 16 V phase arm, 17 W phase arm, 24, 25, 28 Current sensor, 30, 30A, 30B, 30C, 30D, 30E A control unit, 40 Phase voltage operation part for motor control, 42 The PWM signal transformation section for inverters, 50 Inverter input voltage command operation part, 52, 52A, 52B, 52C, 52D, 52E Feedback voltage command operation part, 54 A duty ratio transducer, 100,100A, 100B, 100C, 100D, 100E, 300 Motorised equipment, 301,301A, 301B, 301C, 301D, 301E Motor torque control means, 302,302D electrical-potential-differences conversion control means, 310 Bidirectional converter, 520,520D The control mode judging section, 521 A subtractor, 522 Rate-of-change judging section, The 523 electrical-potential-difference error judging section, 524,524A PI control gain decision section, 525 A PI control machine, the 526,527 output-voltage generation section, 541 Duty ratio operation part for converters, 542 The PWM signal transformation section for converters, B DC power supply, SR1, SR2 System relay, C1, C2 A capacitor, L1,311 A reactor, Q1-Q8,312,313 An NPN transistor, D1-D8,314,315 Diode, M1, M2 AC motor.

[Translation done.]

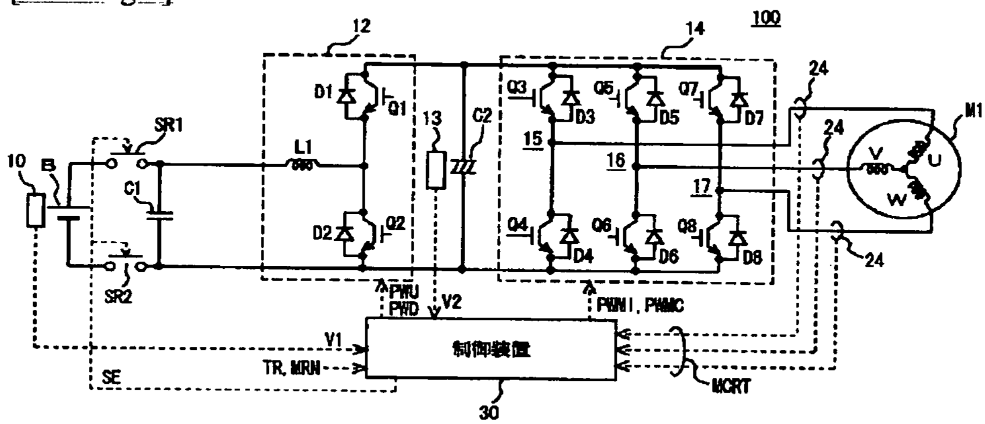
* NOTICES *

JPO and INPIT are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



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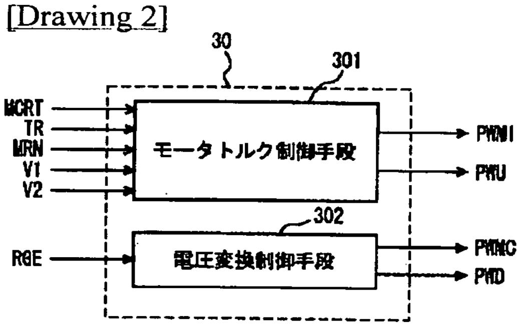

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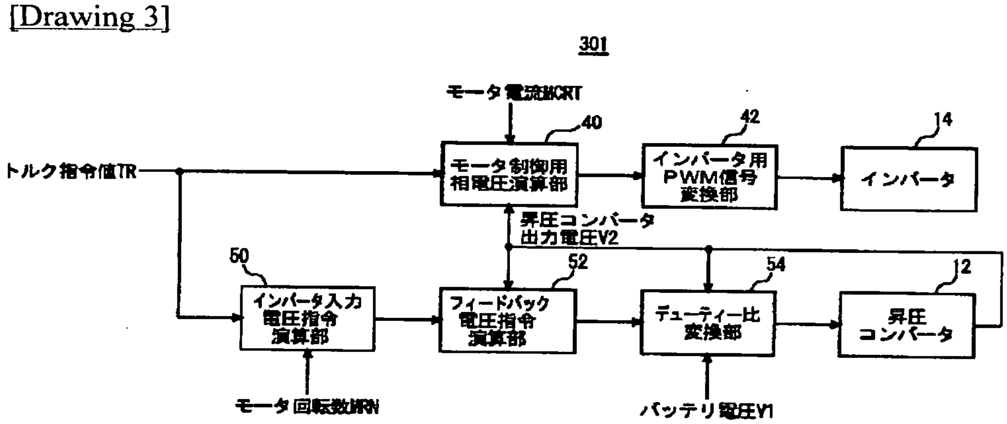

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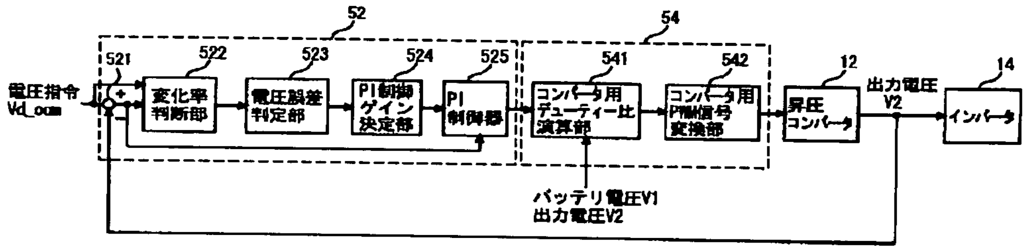

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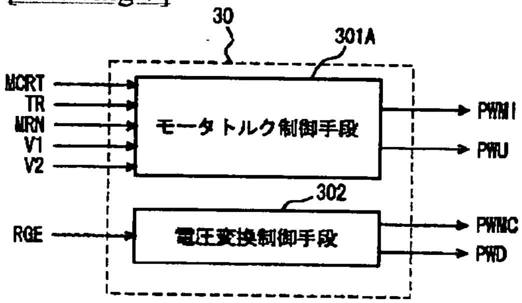

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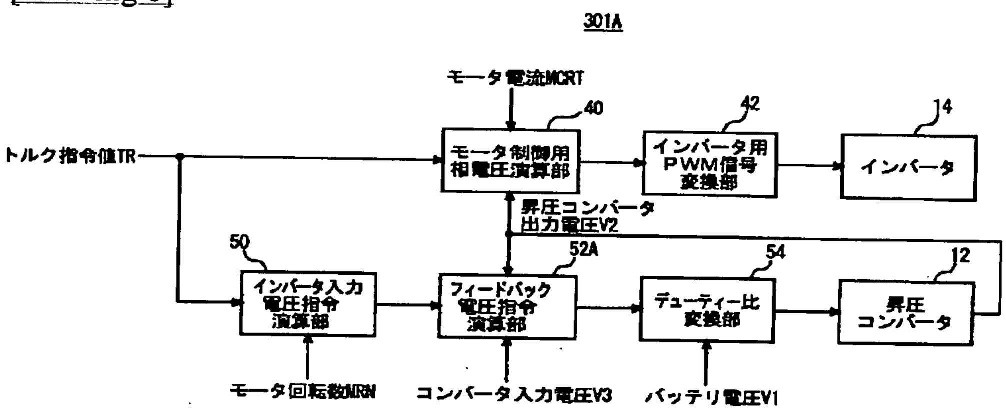

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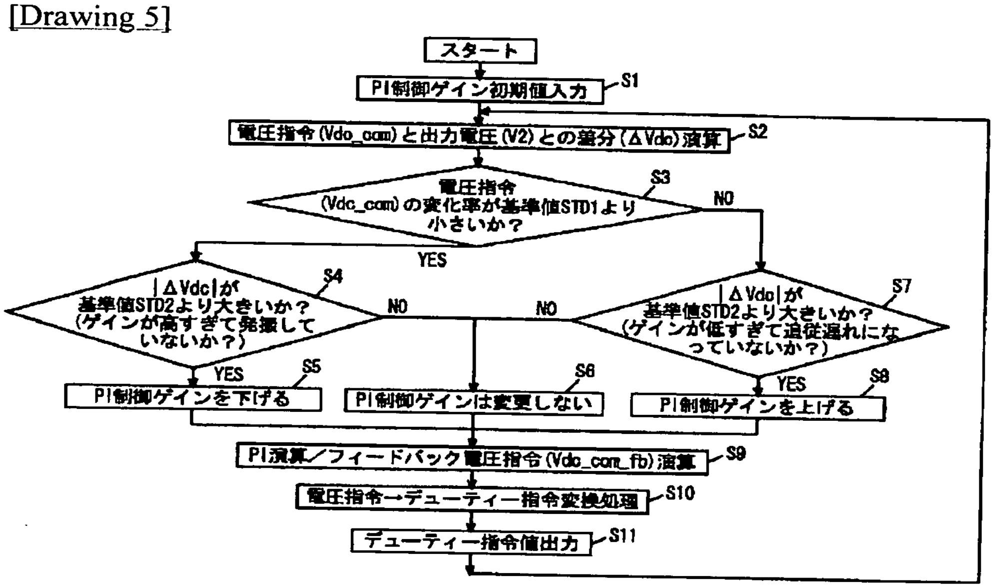

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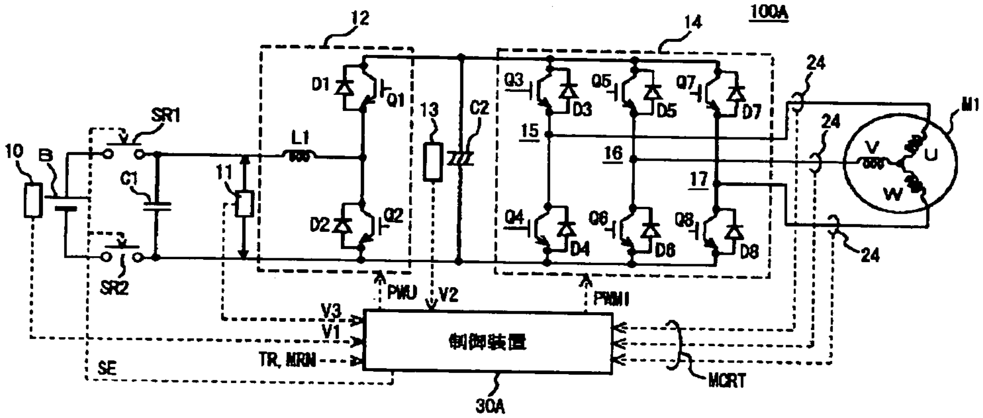

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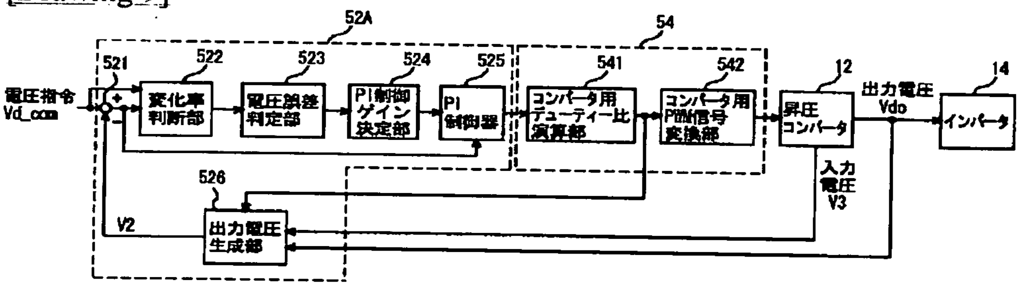

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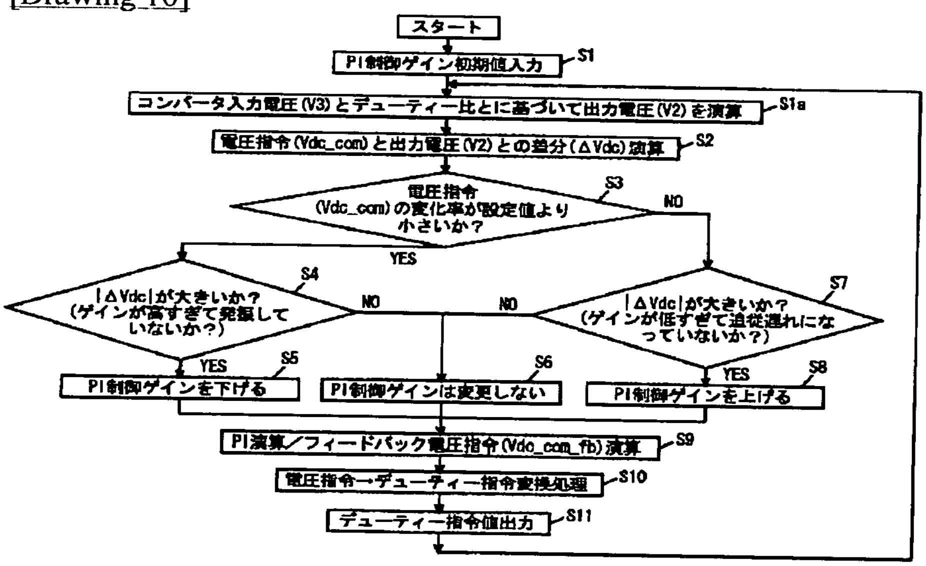

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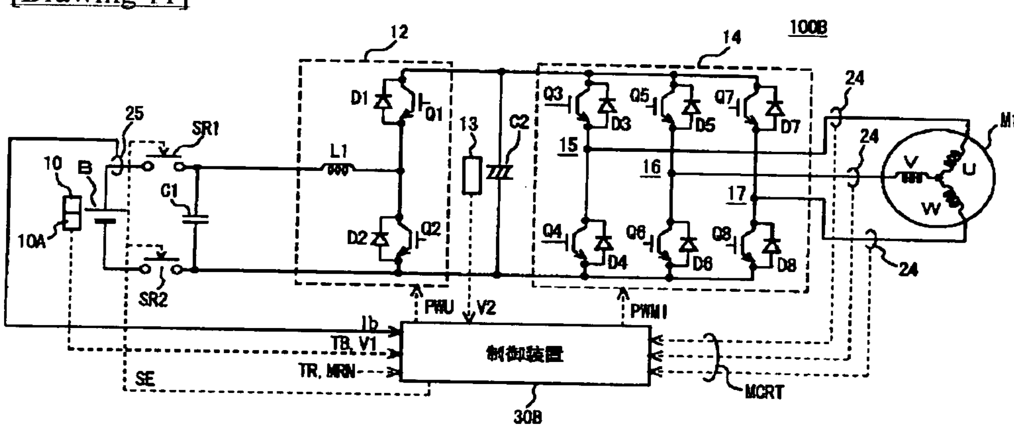

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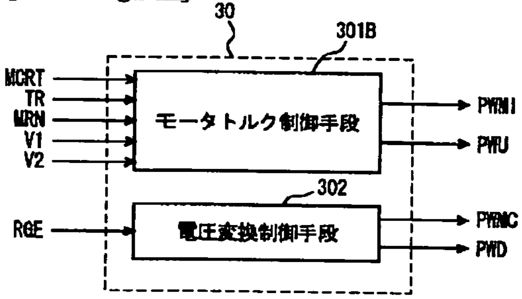

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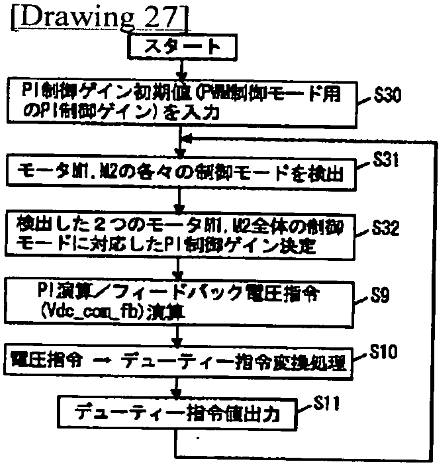
[Drawing 27]



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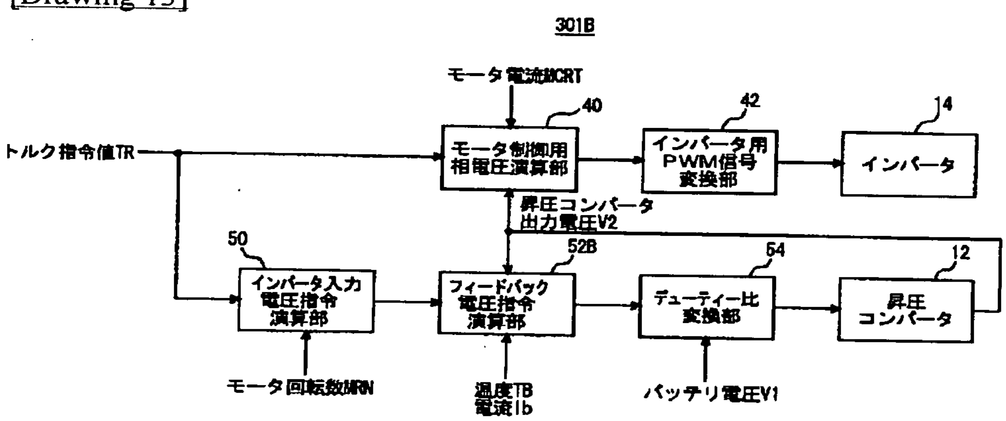

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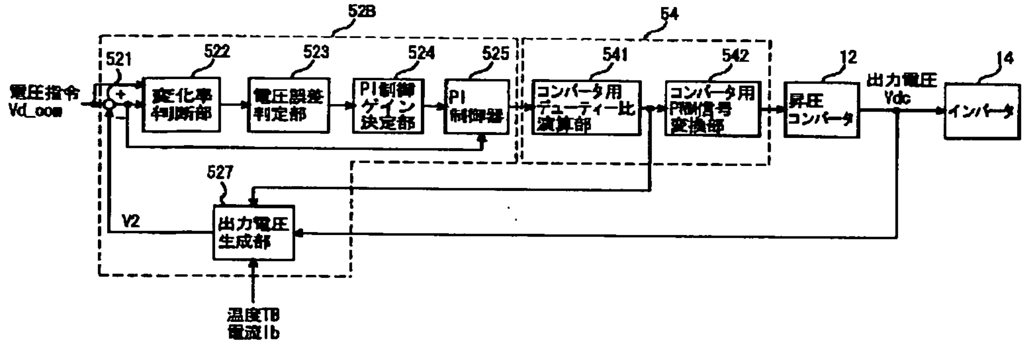

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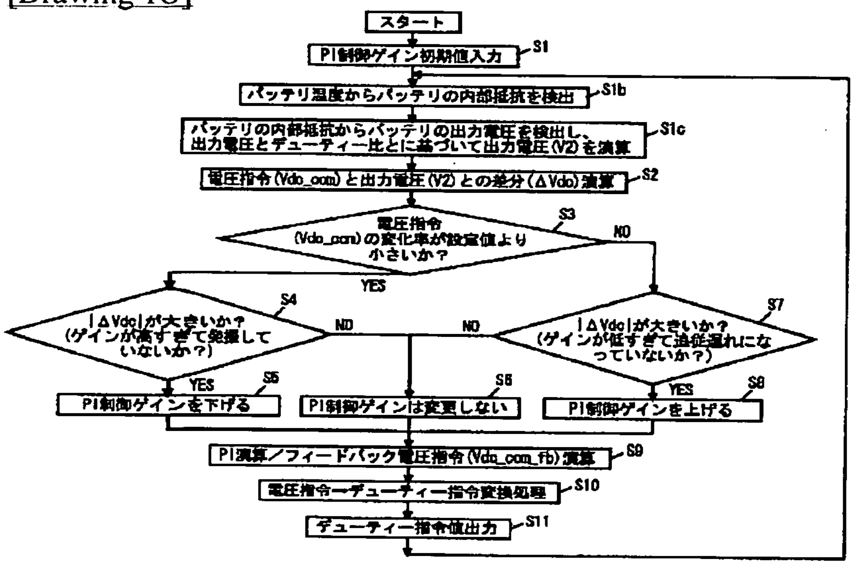

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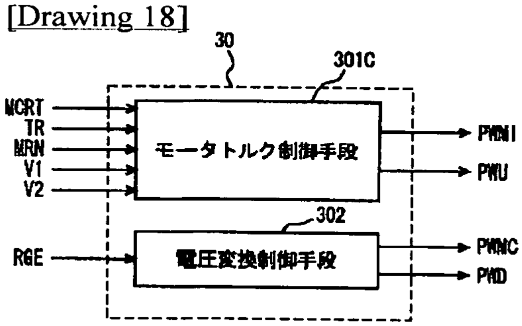

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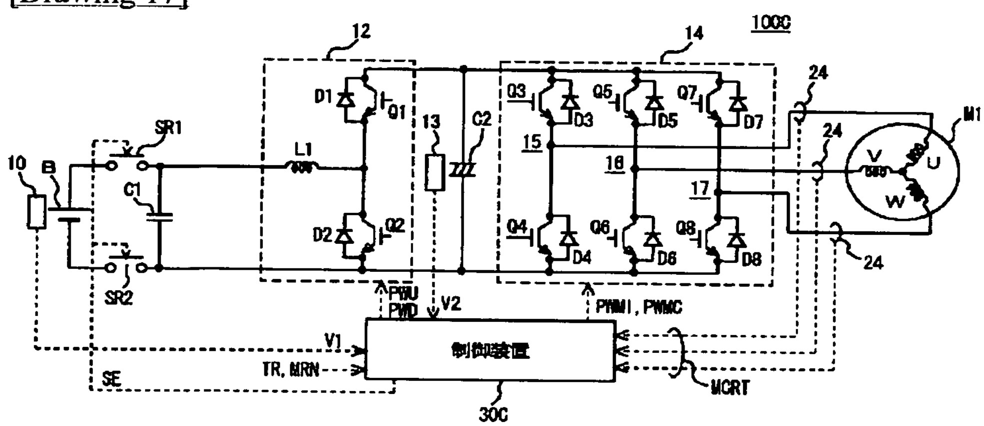

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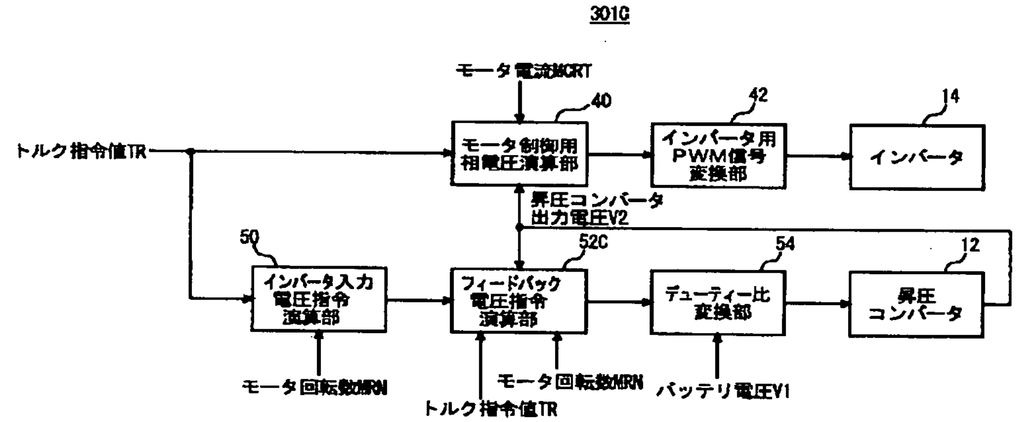

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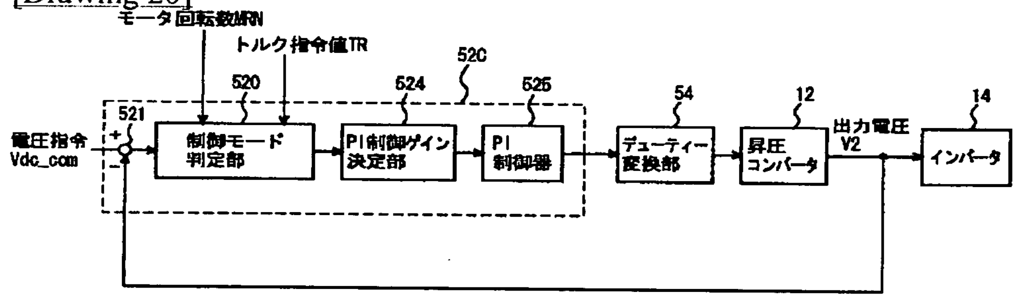

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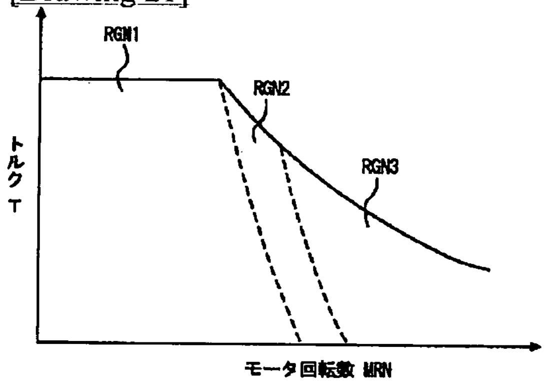

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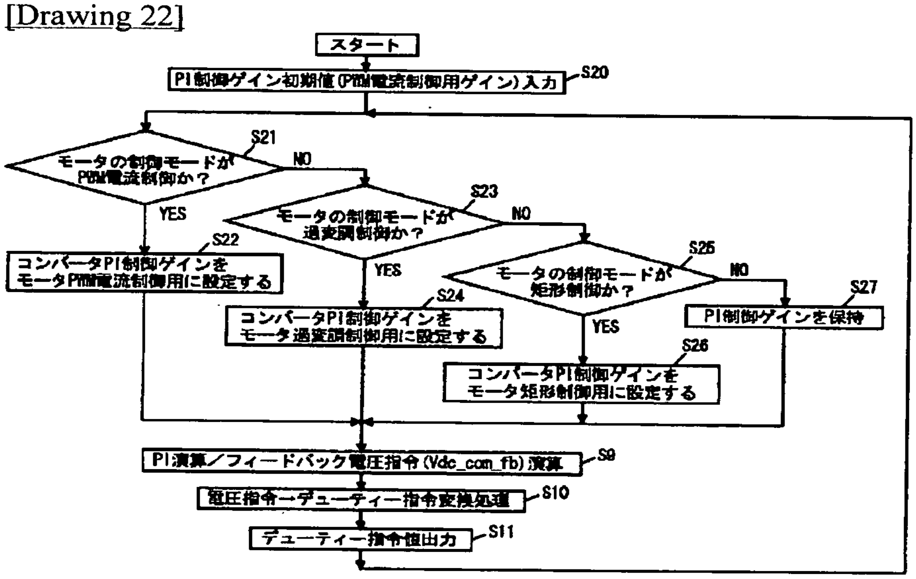

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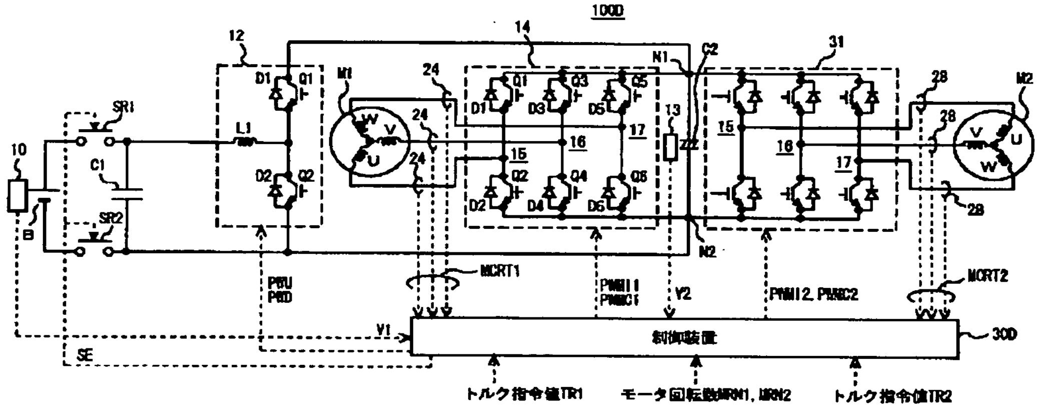

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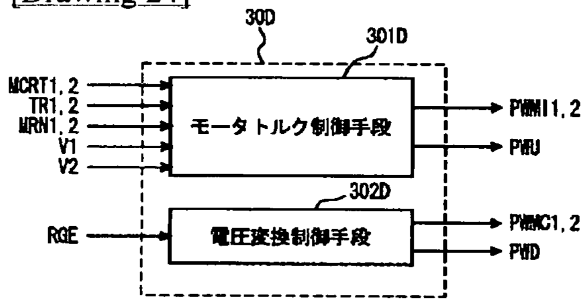

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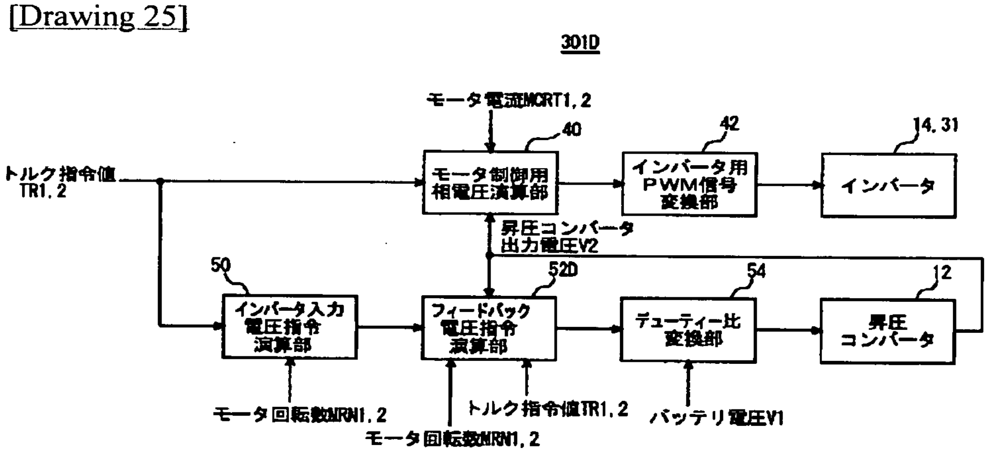

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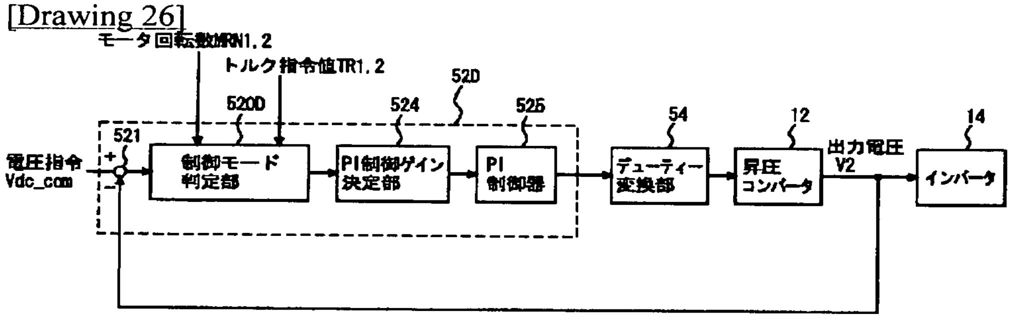

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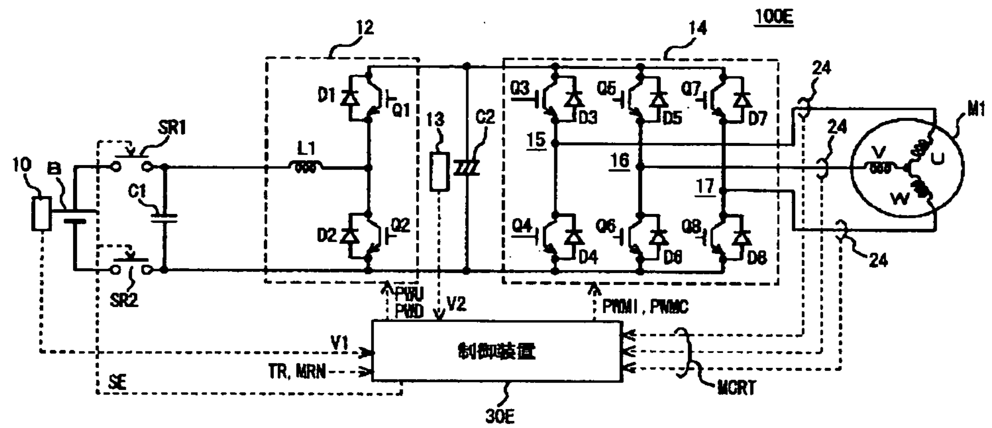

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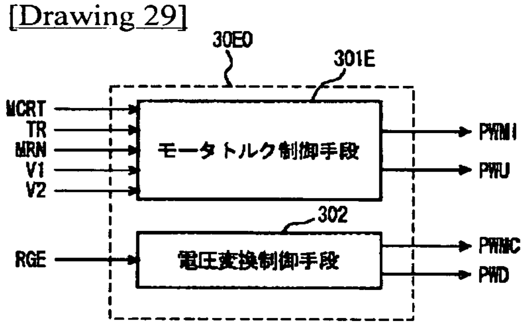

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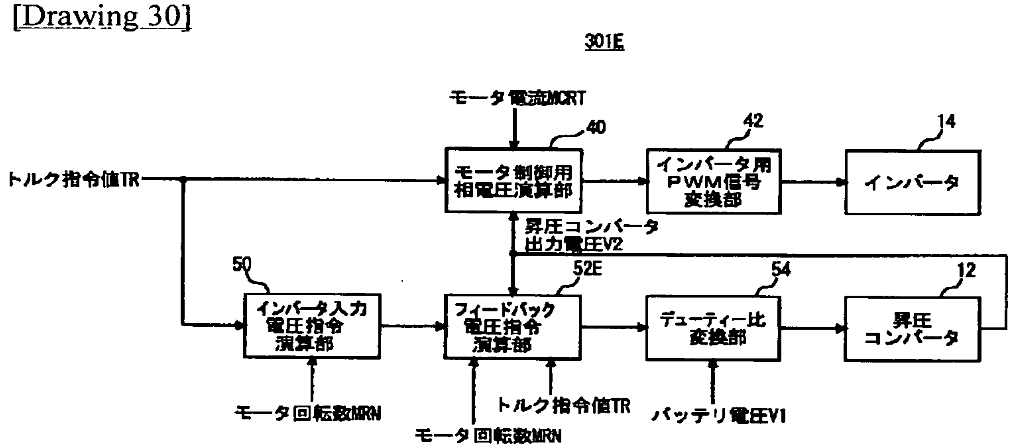

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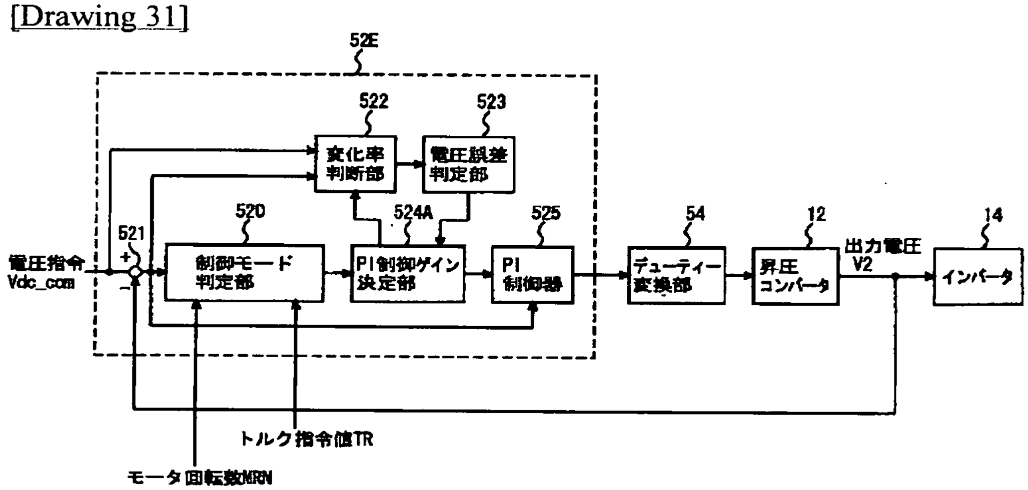

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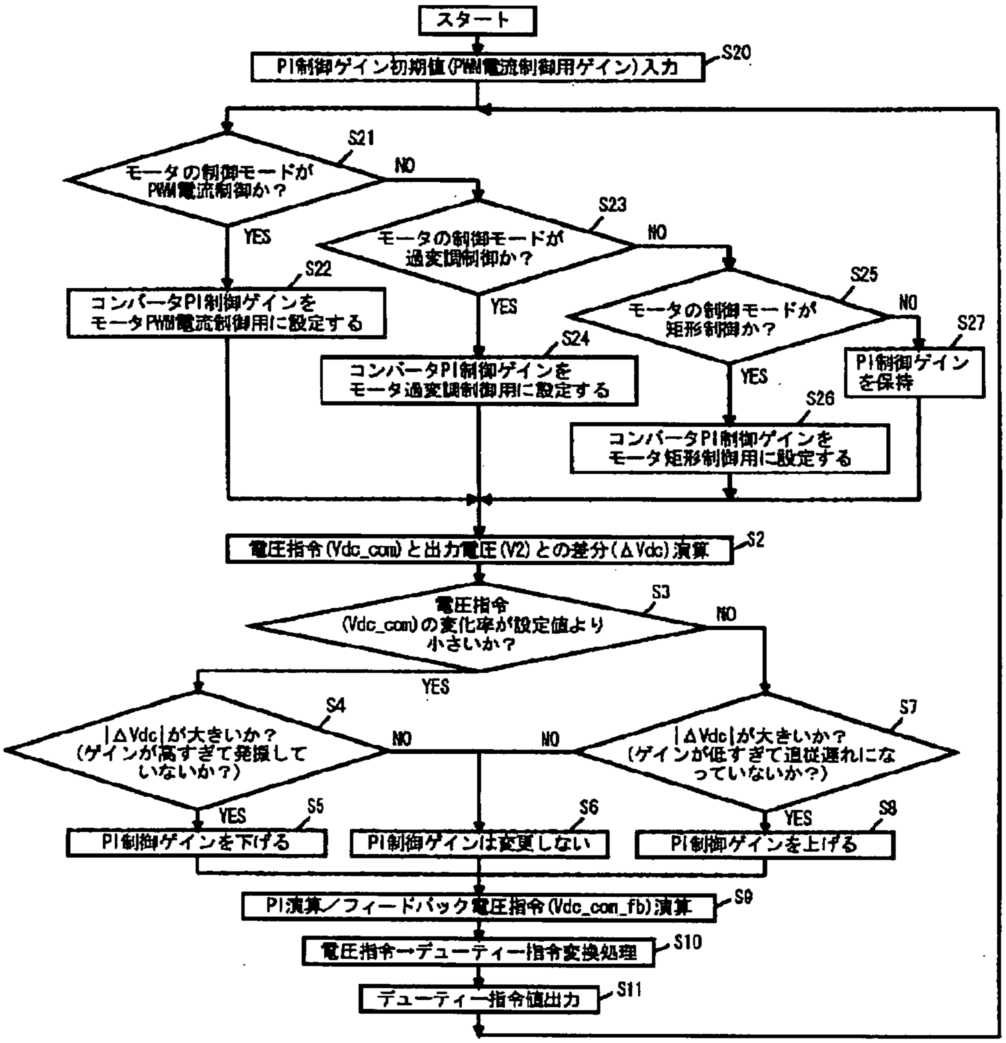

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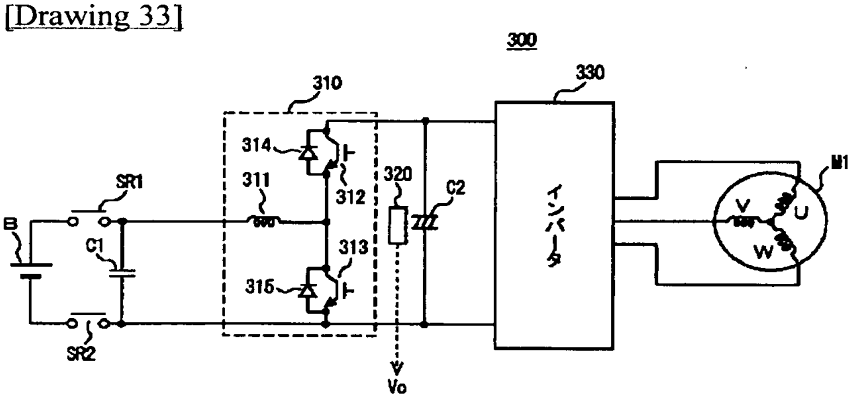

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